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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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[OFFICIAL NOTICE.]

July Meeting, Guild of Gas Managers.

OFFICE OF THE SECRETARY, June 21, 1895.

The July meeting of the Guild of Gas Managers will be held in Young's Hotel, Boston, Mass., at noon, July 13th.

A. K. QUINN, Secretary.

BRIEFLY TOLD.

MUNICIPAL MISMANAGEMENT AT PHILADELPHIA.—Perhaps the advocates of paternal government may be able to satisfactorily explain the action taken by the Common Council of Philadelphia, when that imposing body (it is imposing in point of numbers anyway, for its membership is considerably in excess of 100 representatives), at its session last week calmly ignored the request of the Director of Public Works (Mr. Thompson) for an appropriation up to an amount equal to the construction of an additional gasholder at the Point Breeze station of the city gas works. If the paternalists, however, can evolve a satisfactory explanation they will prove that the logic that is in them is vastly superior to that which they have heretofore propounded; but the holder instance, which attracts our attention just now, seems to be about like the following, no matter whether the paternalists are or are not up to telling us why the action taken is sustainable. In the first place, this is the Philadelphia season for appropriating certain sums needed to keep up the public works, the bulk of which money is to be obtained by issuing a new permanent loan of $1,200,000; and in the second place, it was pretty well understood that by far the largest allotment of the loan was to go towards repaving the city's streets, which, as is conceded both in Philadelphia and out of it, are in a state of dilapidation fully justifying the need of the expenditure of a good, round sum to patch them up. No one would have objected to a fair expenditure on that account, and certainly not the Director of Public Works, whose duty it is to see that the "Public Works" are kept in something like order. The Director, however, seems to have had in his mind the fact that Philadelphia owned something else beside streets—notably a gas works—which property has paid for itself 20 times over, and which, due attention being given to all the circumstances that attend the reception and disposition of the money received for the products which it distributes, has been the golden-egged goose of the Quaker City for many, many years. And remembering this, the Director thought that the gas works ought to share in the good that would come from the judicious expenditure on the plant of a portion of the permanent loan. When the Finance Committee, of Council, acknowledged its willingness to devote the sum of $500,000 towards repaving the streets, while at the same time it disavowed any purpose of complying with the Director's demand for an appropriation for a new holder for the Point Breeze station of the gas works, the Director lost no time in informing the Council, to which the Finance Committee was presumed to be subordinate, that his knowledge of the situation compelled him to say that $500,000 was too large a sum to be devoted to street repairs, when that sum would be equal to meeting the expense account for urgent repaving, and also be elastic to the point of providing for the Point Breeze additional storage. In fact, Mr. Thomp-

son went so far as to say that until that holder storage was provided a large portion of the city was more than liable to be left in darkness because of the unreliability of the existing storage vessels, from which it will be seen that the difficulty at the Point Breeze point is not only in respect of needed new storage there, but is complicated by the rottenness of that already existing. Mr. Thompson's plan was to allot $300,000 to repaving, the balance of the $500,000 to go to new holder construction, which looked to be fairest for the interests of all. The Council decided that all of the money should be spent for paving and "repaving," and now we suppose it is in order for the city to purchase for distribution and use amongst its citizens a goodly supply of bull's-eye lanterns, so that when, in the dark nights of the coming winter season, the pedestrians of the Point Breeze district are plodding their homeward or outward ways over the pavements that were never paved, they may have light to guide them, even though the light be a flicker. Having introduced this mention with the suggestion that the paternalists would be hard set to explain satisfactorily this peculiar action of Philadelphia's Council, we may take leave of the subject by remarking that one good reason for the accepted course is that the Council was paving-mad; that a Council member from the Mayamensing district was paired with a member from the Stratford Hotel section, both to share in the spoils. To put it in a word, it was a case of paving against light, and stones and asphalt won the day.

MR. JENKINS AND HIS NEW FIELD OF DUTY.—Last week we had occasion to say, right at the very last moment, that Mr. E. H. Jenkins had accepted the appointment to assume the engineering charge of the properties of the Covington (Ky.) Gas Light Company, the taking on of the scope of his action to date from July 1st. It is pleasurable, of course, to witness the advance of any man who, having been tried, has been found to be true, and so it is doubly satisfactory to add a word of personal testimony to the worth of the man whose name heads this caption. Tried and true in Columbus, Ga., in his separate working sphere, he never was found wanting in adaptability to cover wider ground, as witness his conduct of the affairs of the Western Gas Association that honored him with the highest office in its gift. Safe, reliable and honest, he leaves Columbus to take charge at Covington; and while we know that Covington has not been a rose bed for those who preceded him, it is still a fact that fair contact and fair help, even in Covington, will enable the Columbus man to do his full duty to his employers with added credit to himself.

NOTES.—At the annual meeting of the Paterson (N. J.) Gas Light Company the Directors chosen were: John Reynolds, W. L. Williams, James Dunne, John S. Cooke, John H. Reynolds, W. H. Williams and A. S. Allen. The Directors subsequently perfected the following organization: President and Treasurer, John Reynolds; Vice-President, W. L. Williams; Secretary, R. Schoonmaker.——The officers chosen at the annual election of the New Brunswick (N. J.) Gas Company were: Directors, H. L. Janeway, J. B. Kirkpatrick, S. V. D. Clark, Lafferd Totten and Loyal T. Ives; President, J. B. Kirkpatrick; Secretary, John W. Newell; Treasurer, Lafferd Totten. The annual reports were quite satisfactory, and when the routine business was concluded the usual round-up at the Mansion House was brought to a successful termination.——The Councilmen of Syracuse, N. Y., who so speedily agreed to a charter for an opposition Gas Company in that city, seem to be floundering between the devil and the deep sea. In this instance the deep sea looks to be the Gas Light Company of Syracuse, whose waves are foamy enough just now to take care of three times the threatened opposition that menaces it.——We understand that Mr. Addicks has secured control of the opposition venture—otherwise known as the Queen City Gas Company—at Buffalo, N. Y. The Wilmington, Del., try does not seem to have taught Mr. Addicks that his bow is permanently bent.

Petroleum in Lower Alsace.

The London *Journal* says that at the recent meeting of the Federated Institution of Mining Engineers, Mr. L. van Werveke gave an account of the petroleum district of Lower Alsace. Petroleum has been proved to exist by borings at various levels to a depth of upwards of 1,000 feet. The winning of petroleum is an industry of great antiquity, and was referred to as ancient by a writer in the 15th century. It used to be carried on by mining, but it is now carried on by borings in the usual manner. The production of crude oil in Lower Alsace last year was 15,632 metric tons, the refined petroleum produced amounting to 4,000 metric tons a year, or 1¼ per cent. of the consumption in Germany. The author quoted the different opinions expressed by various authorities regarding the origin of petroleum, and adduced evidence in support of the view that the original petroleum-bearing stratum belongs to the tertiary period, for both in Upper and Lower Alsace the oil occurs at a particular horizon, that it was a lagoon and delta formation, and that with the decomposing plants, which have yielded the brown coals as well as bitumen and oil, were mingled animal remains from which the nitrogen in the oil is derived.

The Manufacture of Sulphuric Acid by Sulphate of Ammonia Makers.

[A paper read by MR. FLETCHER W. STEVENSON, before the Incorporated Institution of Gas Engineers.]

The manufacture of sulphuric acid is exceedingly simple, and will usually be found profitable to those who are makers of sulphate of ammonia, as the sulphureted hydrogen evolved during the distillation of ammoniacal liquor yields a very considerable proportion of the sulphur required in its manufacture. Sulphate makers have to deal with this sulphureted hydrogen in one of three ways: (1) Absorption in purifiers containing oxide of iron; (2) deposition as brimstone in Claus kilns; (3) buring direct for acid making. Which is the most sensible and the most economical is at once apparent, when it is remembered that the sulphur obtained by the first two methods is sold to acid makers who have their own profit to make after bearing the cost of transit as well as of purchase; while in the last it is utilized *in situ* without labor or charge of any kind. It is believed that, if the ease with which sulphureted hydrogen can be utilized and rendered profitable by burning for the production of sulphuric acid were more generally known, the manufacture of this article would more often be found in connection with large sulphate works; and it is with the hope of turning attention to the subject that the author has ventured to prepare this paper.

Though so many thousands of tons of acid are used annually upon gas works for sulphate making, very little information has ever been laid before meetings of gas engineers upon its manufacture, and to Mr. J. Hepworth must be attributed the credit of first recommending the manufacture and giving particulars of its cost. In 1883 he read before the North of England Gas Managers' Association a paper entitled "Results Obtained in the Manufacture of Sulphate of Ammonia and Sulphuric Acid," and in 1885 another before the Gas Institute on "The Manufacture of Sulphuric Acid in Connection with Gas Works." But in neither of these does Mr. Hepworth recommend the manufacture of acid by direct burning of the spent oxide, while in his second paper he absolutely deprecates it, and recommends in preference the sublimation of the sulphur in the spent oxide, and afterwards burning the sulphur separately. As this is not the plan generally adopted, nor the most economical, the author proposes to give particulars of the plant now in use by the Sheffield Gas Company, and show its special adaptability for those who also manufacture sulphate of ammonia.[1]

Without entering fully into all the reactions taking place during the manufacture, the process of making sulphuric acid in its simplest form may be described as follows: The sulphur required is obtained partly from spent oxide and partly from the sulphureted hydrogen of the ammoniacal liquor distilled for sulphate making. The sulphur, on being burnt in the presence of an excess of air, is oxidized into sulphur dioxide (SO_2). This is further oxidized by nitric acid—given off by the decomposition of soda—into sulphur trioxide (SO_3), and this is hydrated in the chamber by steam into sulphuric acid (H_2SO_4).

The arrangement of the Sheffield Gas Company's chemical works may not be all that could be desired, but it is one for which the author is not responsible; and no doubt the exigencies of the site largely influenced his predecessor in their design.

Steam is obtained from two 30 feet by 7 feet 6 inch Lancashire boilers, fitted with furnaces for burning refuse coke screenings. There are two of Messrs. C. & W. Walker's sulphate stills, each capable of distilling 90 tons of liquor per diem, and having liquor heaters, lime pumps and saturators, etc., complete for each. The liquor is first heated by passing through a coil of pipes laid within an old boiler situated outside the building, into which the waste liquor is run on its way to the open coolers, where it is reduced to a temperature of 100° F. before passing into the sewers. The ammoniacal liquor is further heated before entering the stills to about 160° F. by the hot gases leaving the saturators. The heat of these gases, after being partially utilized in this manner, is further used for raising the temperature of the feed-water to the steam boilers.

In the first set of condensers are fixed coils of 3-inch diameter steam pipe, and through these the feed-water is pumped and raised to a temperature of from 190° to 200° F. A second set of condensers is provided, and a small stream of cold water is run through them as required, to insure the gases being thoroughly cooled. These then pass through scrubbers, consisting of two 30-inch diameter pipes filled with coke, and from them to the oxide burners, where the sulphureted hydrogen (H_2S) is burned to sulphur dioxide (SO_2).

1. After writing his paper Mr. Stevenson heard that Mr. Hepworth had abandoned the method of manufacture recommended by him in his Gas Institute paper, and practically adopted that described by the former.

The spent oxide burners are of the shelf pattern, and consist of six sets, each set having four shelves upon which the oxide to be burnt is placed. They are built of Buckley blue firebrick, obtained from Hawarden, in North Wales. This material is very suitable for the purpose—being harder and more durable than that from Stourbridge, and though it will not stand the heat required for gas retorts, it resists well a temperature of about 1,500° F., which is the highest needed for burning spent oxide. The number of sets may be varied to suit the capacity of plant required, but the six in use at Sheffield will burn off 4 tons of the spent oxide per diem, in addition to the sulphureted hydrogen evolved from 180 tons of liquor.

In the first instance the burners are heated by wood fires, lighted upon the shelves, and afterward, when thoroughly dried, coke is used until a dull red heat is obtained, after which the heat is maintained by the burning sulphur from the spent oxide. The time required for heating up with wood and coke is about a week, or rather longer with newly-built kilns. While heating up, the pipe to the Glover tower is blocked up with a temporary sheet iron chimney, placed upon the main flue leaving the burners. About 3½ cwt. of oxide is the charge for each shelf, and this is burnt off in 24 hours, so that one shelf is recharged each hour. At the same time the shelf next to be charged has the burnt oxide pushed about half way to the back or the hottest part of the shelf; and the charges upon the next two shelves are also stirred up by running an iron slicer underneath and through them.

The charge, when burnt off, is pushed through an opening in the back of the shelf, and falls upon a slide or damper, lying there to cool for several hours, or until the next shelf in the set has to be recharged, when the slide is drawn, and it drops, still inclosed, upon the floor of the sunk chamber. Here it is slaked with water, and can then be shoveled out without inconvenience. Anyone who has witnessed a charge drawn red hot through the front by the usual method, and seen the coughing and choking which attack the spectator consequent upon the escape of sulphurous fumes into the open air, will easily appreciate the improvement effected by pushing the burnt charge through the back as described.

A sample of the burnt oxide is taken just before the charge is pushed upon the slide. These samples are put together, re-sampled, and analyzed once a week. The average weekly sample should not contain more than 4 per cent. of free sulphur in the dry burnt oxide (equal to about 1 per cent. in the original spent). Should it be higher, the remedy is to stir more frequently.

Flues are constructed above and below the shelves of the burners, along which the sulphurous gases pass in their conversion to sulphurous anhydride (SO_2). Those from the two lower shelves drop downward at the back, and then pass to and fro along the flues under the bottom shelf; rising again at the back, and meeting the gases from the two upper shelves, along with which they pass to and fro through similar flues over the top shelf, and thence into the main flue. The sulphureted hydrogen from the saturators is admitted into the flue above the top shelf—a stopcock being provided for each pipe, which is closed just before a shelf in the set to which it is attached is charged, and opened again one hour afterwards.

It is very important that the sulphureted hydrogen should be quite cold on reaching the oxide burners. If warm, deleterious organic substances, which would otherwise be condensed, are passed forward, and, on burning, they oxidize themselves at the expense of the nitrous compounds, and upset very considerably the working of the chambers.

In addition to sulphur, nitric acid is required for the formation of sulphuric acid, and this is obtained from the decomposition of nitrate of soda in cast iron pots, which are fixed in a chamber adjoining the burners. The pots are kept hot by allowing a portion of the gases from the burners to pass around them, their temperature being easily regulated by dampers allowing more or less of the hot gases to come into contact with them.

In starting a sulphuric acid plant, it is advisable to use at first as much nitrate of soda hourly as the pots can conveniently work, which will be about 10 per cent. of the total free sulphur in the spent oxide, the limit being the amount of heat available. Sufficient acid is added to the nitre to render it fluid, the pots being charged alternately until one is nearly full, when the second is charged for about two hours consecutively, so as to enable the first one to work off. Its contents are then run into a cast iron pan and allowed to cool, when the contents are broken up and wheeled away. If, on thrusting an iron bar through the hopper into the nitre cake nitrous fumes are not given off, it may be concluded that the nitre is thoroughly spent. If, when run off, small pieces of nitre are found undecomposed, it may be taken as indicating either that there is insufficient heat or that the pot has not been allowed to run long enough since it was last charged. If the nitre is too thick, and difficulty is experienced in running it off, it indicates either that the heat has been allowed to get too high or that an insufficiency of acid has been used.

From the burners, the sulphurous and nitrous gases pass forward—first through the Glover (or hot) tower, then through the large leaden chambers, and finally through the Gay Lussac (or cold) tower. The Glover tower is 30 feet high and 9 feet square, and is constructed of a strong framework of timber lined with 12-pound lead. The bottom consists of a tray, formed of 40-pound lead, resting upon a brick foundation. The sides are sealed in acid on the tray. It is packed inside with a checkerwork of hard vitrified bricks. It may be said to answer two purposes: (1) concentrating the weak chamber acid by evaporation of a portion of its water; and (2) denitrating the strong acid that has been run down the Gay Lussac tower.

The chambers are formed of light timber framing of sufficient strength to carry the weight of the 7-pound sheet lead top and sides. The bottom of each is formed of sheet lead resting upon close boarding, the lead being turned up to form a shallow tank, in which the acid is deposited as made, and into which the lead sides are sealed. The whole of the chambers are supported upon brick arches; or, if it should be preferred, they may be carried on light brick piers. By far the greatest portion of the acid is deposited in the chambers, the area of which should bear a certain proportion to the quantity of sulphur burned. The capacity usually recommended is about 20 cubic feet per pound of sulphur per 24 hours; but at Sheffield the best results are obtained when the area of chamber space is increased to 30 cubic feet. At Sheffield, the Gay Lussac tower is of similar size to the Glover tower; but it is more usual to make it somewhat higher. It is packed with hard furnace coke, and is used for absorbing the last traces of niter and sulphur.

When re-starting an acid plant, it is necessary, just before the gases from the burners are turned through the Glover tower, to run down it a small stream of acid, in order to prevent overheating. When working regularly, and under normal conditions, the quantity run down each 24 hours is about 9 tons (6 eggs) of acid that has been through the Gay Lussac tower, having a strength of about 148° to 150° Twaddel, and about 3 tons (2 eggs) of acid from the last chamber. The whole of this acid should leave the base of the tower at about 150° Twaddel, and the temperature of it should range from 250° to 300° F. before cooling, and from 60° to 70° F. afterwards. The coolers consist of two circular leaden tanks, about 2 ft. 6 in. diameter and 3 ft. 6 in. deep, containing coils of 1¼-inch pipe, through which cold water is continually running. Once or twice a fortnight the tower should be flushed for three or four hours with as much acid as the overflow at the base will take, in order to prevent any choking. During flushing, the proportion of chamber acid to tower acid is considerably increased. The strong acid containing the niter absorbed in passing down the Gay Lussac tower is stored in separate tanks, and only mixes with the chamber acid as this runs into the distributers on the tower, so as to prevent the loss of niter which would otherwise occur.

It is important that the chamber should always contain sufficient nitrous gases. This may be judged in three ways: (1) Color of the gases as seen in the daytime through the propagating glasses fixed on top of each chamber (except the first), and at night through windows in the sides illuminated by gas lights. In normal working, the gases in the first chamber are always white; in the second, slightly orange; in the third, rather deeper orange; and in the last, deeper still. (2) The amount of nitrous gases present in the acid leaving the Gay Lussac tower, which should be equal to about 8 or 9 c.c. of nitric oxide per cubic centimeter of acid. (3) The test of the exit gases into the chimney, which, under the Alkali Works Regulation Acts, must not exceed 4 grains acidity (estimated as SO_3) per cubic foot of gas. But, in good working, 2 grains should rarely be exceeded; and it would usually range from 0.5 to 1 grain.

Should the color of the gases in the chambers be too pale, or the quantity of nitrous gases in the acid leaving the Gay Lussac tower fall much below 8 c.c., or the exit test be too high, additional niter must be used, and *vice versa*.

The air required for burning the oxide and sulphureted hydrogen, and for absorption of the nitrous gases in the chambers, is admitted through the fronts of the burners. The exit damper should be so regulated that there is a gentle pull in at the front of these, and a test of the exit gases should show 8 to 10 per cent. of free oxygen. Insufficient air would cause imperfect combustion of sulphur and loss of nitrous gases through imperfect oxidation, while too much air would be waste of chamber space and loss of gases through excessive draught on the exit.

The quantity of steam required in the chambers is shown by the specific gravity of the acid made, as indicated by the drips; and it depends very much upon the amount of moisture in the spent oxide, the quantity of acid concentrated by the Glover tower, and the quantity of sulphureted hydrogen burnt. It will not often be necessary to put steam into the first chamber; but should the strength of acid from the drips rise above about 130° Twaddel, it must be reduced by the addition of steam. The drips in No. 2 chamber should range from 120° to 130° Twaddel; in No. 3, from 110° to 120° Twaddel, and in No. 4, from 105° to 115° Twaddel. The power of the acid running down the Gay Lussac tower to absorb niter depends very much on its strength and temperature. It should be not less than 150° Twaddel strength, nor hotter than 70° F.

The "eggs" mentioned are of cast iron, and situated below the ground level, so that acid from any of the store tanks or chambers can be run into them, and forced up into the tower or saturator tanks by air pressure obtained from a blowing engine.

The quantity of acid produced is easily varied according to the make of sulphate. For two or three months in the winter, both sulphate stills are in use—producing 80 tons of salt a week. During this time the burners are charged to their full capacity with 4 tons of spent oxide a day—producing the required quantity of acid for the sulphate made. During the remainder of the year one sulphate still only is at work, and the charges of oxide in the burners are reduced by one-half.

Both sulphate and acid plant are equal to an annual production of 3,000 tons of sulphate; though, up to now, 2,341 tons is the most that has been made in one year. The acid plant described could, at the present prices of lead, be erected complete for $25,000 to $30,000.

The labor, when working the acid plant at its full capacity, consists of three process men—one for each shift of eight hours—and a laborer in the daytime, who wheels up the spent oxide and takes away the burnt.

During the year ended June last, 1,977 tons of acid, calculated to 148° Twaddel strength, were made, of which the following table gives the details of cost of manufacture, exclusive of repairs. These being exceptionally light, an average of four years is taken:

	Amount.	Per Ton of Acid.
1,023 tons of spent oxide, 45 per cent. sulphur, at 10.66 cents per unit	$5,115 00	$2 58
49½ tons nitrate of soda	2,228 25	1 13
342½ tons coke screenings for fuel	231 85	11
Wages for labor in manufacture	1,455 60	73
Repairs and renewals of plant, being an average for four years	3,010 33	1 53
	$12,041 03	$6 08
Add 5 per cent. interest on $30,000, the estimated cost of the plant	1,500 00	76
Total	$13,541 03	$6 84

Thus, for the period at present under review, the cost of 148° Twaddel acid, including interest on capital outlay, was less than $6.88 per ton. For comparison, however, it is considered better to state the cost of the acid at an amount per ton of sulphate made, as the quantity used may vary according to strength and quality. During the same period 2,144 tons of sulphate were produced, and 1,895 tons of 148° Twaddel acid were used in its manufacture, which, at the above price of $6.88 per ton, is equal to a cost for acid of $6.08 per ton of sulphate made. This low cost for acid is partly attributable to the utilization of the sulphureted hydrogen obtained in the distillation of the ammoniacal liquor. The sulphur from this source is practically about one-fifth of the whole quantity required for the acid made.

It will be seen from the foregoing table that, during the year, 1,023 tons of spent oxide were burnt, containing 45 per cent. of sulphur, or 460 tons of actual sulphur. During the same period, 32,549 tons of ammoniacal liquor were distilled, containing an average of 0.55 per cent. of sulphureted hydrogen, or about 191 tons of sulphur, or 29 per cent. of the total sulphur available. As, however, some of this is necessarily lost by combination with the lime used in the stills to liberate fixed ammonia, and some also passes away with the condensed water, it is found in practice to represent, as stated, about 20 per cent. of the total sulphur burned. This means that, if the sulphureted hydrogen were not thus utilized, about 255 tons more of the spent oxide would have to be used, at an increased cost of $1,275. To this, however, must be added interest on the outlay for purifiers or Claus plant. The cost of either could not be less than $7,500, representing a cost for interest, at 5 per cent., of $375 a year, or a total saving of at least $1,650 a year. In other words, the value of the sulphureted hydrogen provides a sum more than sufficient to pay 5 per cent. interest on all the outlay required for complete sulphuric acid plant.

Whether the manufacture of sulphuric acid can be profitably adopted must, of course, to some degree, depend upon local circumstances. But there can be no objection to its adoption on the grounds of nuisance; as from this it is entirely free. Moreover, the manufacture is simple; and the author hopes he has proved it to be economical also. Mr. Hepworth showed that, in Carlisle—where 15,000 tons of coal a year were being carbonized—acid manufacture was profitable, and the author can unhesitatingly recommend it where works approach in size those of the Sheffield Gas Company.

In conclusion, the author desires to acknowledge the assistance he has received, in the preparation of this paper, from Mr. G. T. Calvert, the Superintendent of the Sheffield Gas Company's chemical works.

Discussion.

The President said he thought the members would highly appreciate this paper. It was extremely difficult for outsiders to get any information with regard to the working of chemical operations. When the manufacture of such an important product as sulphuric acid was in operation at a works like those of the Sheffield Company, it gave an opportunity of which Mr. Stevenson had availed himself, and the benefit of which he had now given to the members. From what he had stated, they could now judge of the extent to which it would be worth while for gas undertakings to take up this manufacture. It was really an important matter when it was considered how important sulphuric acid was for the profitable working up of sulphate from gas liquor.

Mr. Lewis T. Wright (London) said he had had some experience with the manufacture of sulphuric acid on somewhat the same scale as appeared to obtain in Sheffield. Mr. Stevenson had rendered a distinct service to the Institution by bringing this matter so ably before them, as such papers were rare. One of the criteria of success in acid making was the consumption of niter; and he was rather struck by the large amount of niter which appeared to be consumed at Sheffield. In a works able to choose its supply of sulphur material—and this was not the case at Sheffield—3 per cent. of niter on the sulphur charged was considered to be good working; but in this case the consumption was 9.2 per cent., which was rather large. Of course, they knew that the gas which came away from the saturators was not as pure as it might be. In addition to containing carbonic acid, which was not a useful diluent, in the acid chamber it contained organic compounds, which Mr. Stevenson had referred to; and it was commonly supposed that the use of these gases in the saturators necessitated an increased quantity of niter. Again, it was believed that spent oxide contained bodies which also called for a greater consumption of niter. But having worked with both the gases from the saturator and spent oxide, and having been able to produce sulphuric acid with a very much less consumption of niter, he should have thought probably that there might be some other cause, though perhaps in this case the spent oxide was not particularly pure. The amount of sulphur, as calculated from the sulphuric acid, would be 539 tons; and the amount calculated from the spent oxide (deducting 4 per cent. said to be left in the residue) was 419 tons—leaving 120 tons as the sulphur provided by the waste gas from the saturators, or 22 per cent. It would be interesting if any gentleman who had the opportunity of studying the action of this sulphuric acid plant could experiment, and see what was the increased consumption of niter due to the gases which came from the saturator. It might be that the economy was not so great as it appeared. There was unquestionably an economy in this case, resulting in 120 tons of sulphur; but it might be that the use of these gases from the saturator was attended with the increased quantity of niter consumed, and would somewhat discount the economy. Possibly this matter might not have escaped Mr. Stevenson's attention; and, if so, he should be glad to know if the large amount of niter was to be attributed to the spent oxide or to the waste gases.

Mr. B. W. Smith (Smethwick) asked how it was that the sulphur was charged at 10.66 cents per unit, while the oxide was only 45 per cent.? This was a low percentage, and 10.66 cents seemed an exceedingly high rate.

Mr. S. Glover (St. Helens) having had some experience in the works referred to, had been much interested in the paper. They must all feel that the best use had been made of the site in arranging the different operations and chambers shown on the diagram. Turning this question over in his mind, he was wondering what was the smallest gas works at which it would be profitable to make sulphuric acid. Of course the possibility of making sulphuric acid depended upon the method of purification adopted. In works where lime was used for

purification exclusively, it would be impossible to use the spent material for acid making, and even if oxide was adopted entirely for purification, the question was in what sized works would it be profitable. At Sheffield, where the make of sulphur and spent oxide was considerable (much larger than at many works), the profit was very small, he should think, compared with the price at which acid could be bought, which in some towns was about $6.50 a ton for manufacturing sulphate of ammonia, or in towns like Carlisle, at a distance from the chemical works, acid could be bought at $8.

Mr. Stevenson asked what kind of acid Mr. Glover referred to?

Mr. Glover said pyrites 144°. For a works making 200 tons of sulphate a year, or a works making about 200 million feet of gas, if the saving was taken at $2 per ton it would only amount to $400, assuming that the manufacture could be conducted as economically as at Sheffield. To effect so small a saving, few engineers would undertake the responsibility of putting down a plant to manufacture sulphuric acid. With reference to the size of the apparatus, the chamber space recommended was greater than that usually allowed, and for smaller works the area would have to be much larger in proportion, which would increase the cost of the plant. Again, it would not be advisable to have works of this kind unless sufficient chemical assistance was provided. Frequent tests were necessary of the materials, waste gases, and the acid, in order to prevent excessive wear of the plant, which might easily be brought about by the carelessness of the men.

Mr. T. Holgate (Halifax) said it was a very important question whether it was desirable to make sulphuric acid, or to convert the sulphur to brimstone. When Chance's sulphur-recovery process was introduced, a good many chemical manufacturers preferred to burn sulphureted hydrogen into brimstone, knowing they could make their acid from pyrites, which could be obtained at much less cost. He was informed by manufacturers of acid that they had now no difficulty in getting pyrites free from arsenic, so that the principal difficulty was removed, and, that being so, he thought each case would have to be considered on its own merits—whether it would be more profitable to make brimstone or acid. A wider view might be taken of this subject, and that was the one adopted by M. de Lachomette, the Engineer to the Lyons Gas Company. He attempted to make sulphate of ammonia direct by the combustion of sulphur into sulphur dioxide, causing it to unite with ammonia—first making ammonium sulphite, and then oxidizing that by a blast of air into sulphate. He believed that his experiments were successful to some extent, but the final difficulty appeared to be in the perfect oxidation of the sulphite. It would be unwise to dismiss this problem, because there seemed to be a possibility of causing a direct union of the kind to be accomplished by an action similar to that which took place in the Referees' sulphur test. They had there ammonia brought into contact with sulphur dioxide, and a current of air in the chimney seemed to oxidize fairly well the sulphur dioxide into sulphur trioxide, and then what they received into the condenser was sulphate of ammonia.

Mr. Fletcher Stevenson, in replying, after thanking Mr. Wright for his kind remarks, said he must admit the percentage of nitre used was high. He knew many works where it was lower, and he thought they would be able to reduce it considerably at Sheffield, though whether they would get it down to 3 per cent. he could not say. That the gas from the saturators did not affect this he was quite certain. When he first of all went to Sheffield, the gases were not burnt for sulphureted hydrogen, and they used a larger quantity of nitre than they did now. Another gentleman remarked that he charged sulphur at a very high rate, but that was the price delivered into their works. Of course they produced it themselves; but it was delivered into the chemical works, and charged no doubt at a price slightly above that for which it could actually be purchased. He preferred to charge it too high than too low. If they charged less, the cost of the acid would come out proportionately less. Mr. Glover said pyrites acid could be bought at $6.88, which was practically the price he had given for oxide acid. He was quite certain that most engineers who had had experience of both pyrites and oxide acid would agree with him that they would never go back to pyrites acid if they could get oxide acid at the same price—that is, if the arsenic were left in, which gave rise to a great deal of trouble and annoyance, and to get rid of the arsenic meant extra cost. He was told that, in the Warrington district, the cost of taking out the arsenic was about $1.88 a ton, 148° Twaddel. That was the actual quotation to a gas works for a year's supply. Mr. Holgate raised the question whether it would not be better to convert sulphur from the oxide into brimstone and make the acid from pyrites; but, as he had pointed out in the paper, this would involve expenditure for plant which, with the process he had described; was altogether unnecessary. Moreover at Sheffield, as the works were cramped, it would be very difficult indeed to find accommodation for a Claus kiln.

A New Shaft Governor.

[A paper read by Mr. E. J. Armstrong, Oswego, N. Y., at the Detroit Meeting, Am. Soc. Mechanical Engineers.]

Probably the most essential qualification of a good governor is stability. A small drop in speed, under load, usually does no harm, but instability is a fault not to be tolerated; to combine stability, sensitiveness, and close regulation, has always been a difficult problem. In the single-weight type of governor, originally invented by our Past-President, Prof. John E. Sweet, and built by him and others for a number of years, the principle aimed at has been to employ a heavy fly-weight, revolving in the largest possible circle, and to reduce the inertia and friction of all connected parts to a minimum. So designed, the action of the governor is extremely quick, passing through its entire range in one-quarter of a second, when the full load is instantly thrown on or off. If not adjusted too close to isochronism, the stability is nearly perfect. Two per cent. drop between no load and five-eighths cut-off, equivalent to about 1 per cent. between no load and one-fourth cut-off, will, at 300 revolutions, give such a degree of stability that, with the load held steady by Prony brake, indicator cards traced continuously for a minute, show lines only about one thirty-second of an inch wide at any point. Much closer adjustment is liable to develop a tendency to race, and is for that reason impracticable. This unavoidable drop, while very seldom being of any consequence in actual service, has sometimes been urged as an objection, perhaps by the other salesman, and it has seemed desirable to at least be able to give closer regulation. Being unwilling to secure a smaller drop in speed by any device which would affect stability, or in any way retard the quick response of the governor to a change in load, the writer devised and built a governor, in which

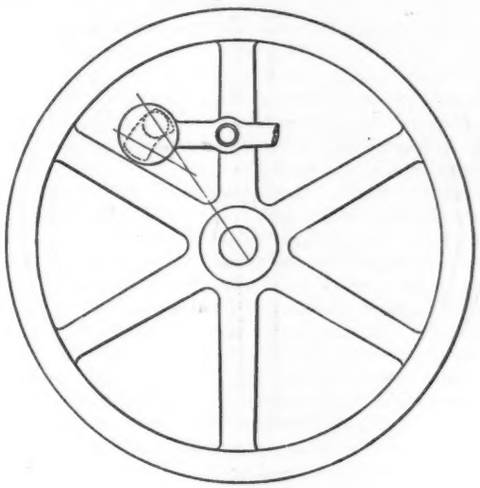


Fig. 1.

Fig. 2.

a shifting weight was employed, as shown in Figs. 1 to 3, so arranged that for every position of the governor there would be a corresponding point of equilibrium for the shifting weight. If there is a certain drop in speed between the extreme outer and inner positions of the governor (Figs. 1 and 2), the shifting weight and the curved chamber in which it rolls are so proportioned that its weight, transferred from one position

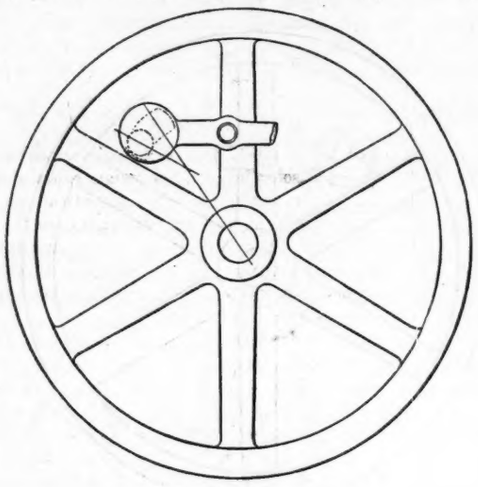


Fig. 3.

to the other, will just balance this drop, by changing the center of gravity of the governor weight as a whole, and so maintain a uniform speed throughout the governor range. To illustrate: Suppose an engine, running, say, 300 revolutions without load, and the governor weight in the position shown in Fig. 2. the shifting weight being in its outer position. Upon a hoavy load, requiring three-quarter cut-off for its negotiation, being suddenly thrown on, the fly-weight will immediately take the position shown in Fig. 3, and will drop to, say, 295 revolutions; then the shifting weight, being out of equilibrium, rolls over into the position of Fig. 1, in which position its leverage upon the spring is reduced, and it must in consequence run 300 revolutions to again balance the spring. The shifting weight is simply a short, solid cylinder, and

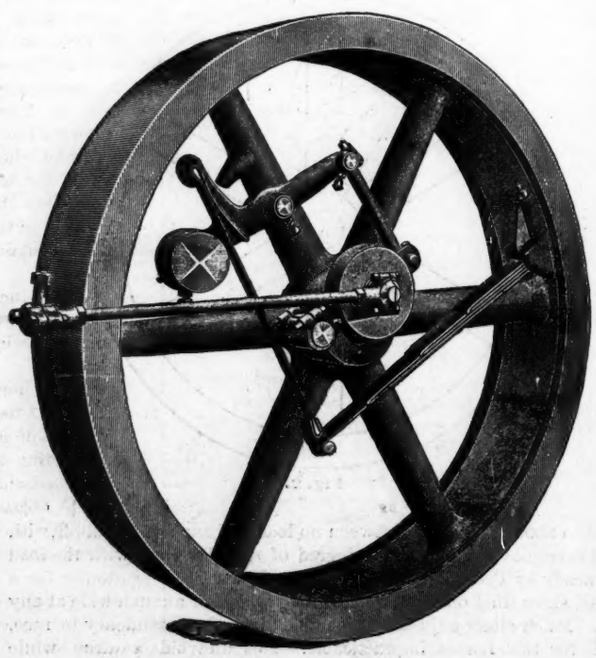


Fig. 4.

the curved chamber in which it rolls is filled with oil. Its fit in this cylinder is sufficiently loose to permit the passage of oil past it, as it rolls from one position to another, thus acting on a dash pot, to prevent its movements being rapid enough to interfere with the stability of the governor. The effect is to make the governor practically isochronous. Instantaneous changes of load are not usually of large amount, and therefore the error the shifting weight has to correct each time is small. If the loads change more gradually, the speed does not vary at all perceptibly, for the shifting weight corrects for each small change nearly as soon as made. It is entirely practicable to over-correct in this manner, and so produce a governor which will run considerably faster loaded than light. Just how far this can be carried the writer does not know, but its capabilities in this direction are certainly beyond any probable requirements of practice. Arranged in this way, and with the load slowly applied, the tachometer needle steadily moves upward, precisely as with the ordinary governor it moves downward under the same conditions.

A variation of the scheme, upon which the writer is at present experimenting, consists simply in the use of oil or other liquid, as the shifting weight. This has the advantage of permitting a small weight to be shifted through a large range, which is quite desirable, and it is also somewhat simpler, though the device illustrated adds but one moving piece to the governor.

Longitudinal Expansion of Steam Mains.

A writer in *Iron Age* remarks that the variations of length, due to changes of temperature, of steam pipes constitute a subject of much greater importance than is usually attributed to it, and one well worthy of consideration as to its extent and effects. The practice is so common as to become almost the rule rather than the exception in the erection of steam plants of moderate size, employing main steam pipes of from 4 to 6 or even 8 or 9 inches diameter, to pay no attention whatever to the question as to whether the conditions are such as would properly require the use of some form of compensating device whereby the objectionable effects of variations of length in the pipe may be neutralized. From the fact that the calculations necessary for the solution of the problem are exceedingly simple, and also that there are numerous well-known forms of expansion devices, it would seem that only a want of appreciation of the importance of the subject can reasonably account for its being so frequently ignored. A few figures, therefore, may not be amiss in illustration of the amount of variation occurring under ordinary conditions and in average cases as to details of arrangement of plant. It is assumed that the pipe is of wrought iron, the expansion coefficient of which is 0.000006689, *i. e.*, it will expand or contract that fraction of its entire length for each degree (Fahrenheit) of increase or decrease of its temperature. Let us consider the conditions of a case actually existing (by no means an exceptional one), in which the theoretical calculations were subsequently verified by actual measurement.

A battery of four horizontal boilers was connected by a transverse 6-inch header, from the center of which was led the main steam pipe to a 100-horse power engine about 42 feet distant. The pipe was 6 inches diameter for about 25 feet from header, and the balance of its length 5 inches. It was supported by hangers from the ceiling timbers, and was practically horizontal, no dip having been allowed for drainage.

It will be understood that the connection to the main header was by means of a horizontal T, without the interposition of the riser usually employed, although the header was connected to each boiler by means of a riser of 4-inch wrought pipe in which the stop valve was located, the total length being about 30 inches from flange to center of header. At the engine a vertical drop of 5 feet was connected at the top by a screwed cast iron L, and at the bottom to the steam chest by an ordinary 5-inch angle globe valve serving as the throttle, and a horizontal pipe 22 inches long, at right angle with line of main pipe. Connection with steam chest was by bolted flange, the joint being a rubber gasket.

As the engine was somewhat overloaded it was necessary to carry 80 pounds steam. It was the practice to blow off on Saturday night, and in cold weather the temperature of engine and boiler rooms frequently fell to far below freezing point between Saturday night and Monday morning.

The conditions affecting the expansion of pipe are variations of temperature—from 32 to 324° the temperature of 80 pounds pressure = 292°; length of pipe 42 feet × 12 inches = 504 inches; co-efficient of expansion in terms of its length 0.000006689. Then 0.000006689 × 504 inches × 292° = 0.984406752, or nearly 1 inch. Or, taking a minimum temperature of 60°, it will be 0.000006689 × 504 × (324—60) = 264° = 0.890011584, or over ⅞ inch. Premising, of course, that the pipe in question was entirely without any means of compensation for this increase of length (increase, because it was made of the proper length at the lower temperature), let us see what will be its probable effect. As the

expansion of the metal exerts a practically irresistible force, at least within the limit of its ultimate compressive strength, some part or parts of the system described must yield to the strain; and it will be, of course, those least capable of resistance. The 42 feet of main pipe will be in compression, but owing to its relatively large diameter will have a strength far in excess of other parts. It may be regarded as a column supporting an equally distributed load. The header becomes a beam supported at both ends and loaded in the middle, but owing to its large diameter and short distance between supports (about 8 feet) it, in turn, is stronger than the vertical members—*i. e.*, the risers from boiler and the drop at engine. These we may consider as beams fixed at one end and loaded at the other, but owing to the lesser length of the risers the drop becomes the element least capable of resistance, and it is, therefore, at this point that most of the yielding to the strain must occur; in other words, the lengthening of pipe is almost entirely from a fixed point at the boiler to a yielding point at engine, a condition which will obtain in a majority of cases where no expansion device is employed.

The most marked visible effects of the strain were observed at the throttle valve and the flange connection to engine. The valve body, subjected to the severe twisting strain due to the manner in which it was connected, was so badly sprung that it was impossible to properly close it, although the bearing on the valve face and the seat indicated that it was absolutely tight when the pipe was cold. The 22-inch length from throttle to flange was subjected to both torsional and transverse strains, and the effect was manifested in the frequent blowing out of the gasket forming the joint between the pipe flange and steam chest, which always occurred on the side opposite the direction of elongation.

At the boiler end of pipe the only effect noticeable was in the continued leakage of the stop valves in the two risers next to the main pipe connection with header. That this leakage was due to the strain was clearly shown by the fact that while it always occurred when the pipe was hot from the flow of steam, it gradually lessened and ceased entirely as the pipe cooled after closing, thereby indicating that the valves were not permanently sprung beyond the elastic limit.

This enumeration includes all of the most important visible effects of the elongation of pipe; but there are others, not visible, of a far more serious nature, inasmuch as they are a constant menace to life and property. Considering the nature of the strains as indicated by the effects already referred to, we find at the boiler end of the system a liability to fracture of the cast iron bodies of the 4-inch stop valves in the two risers adjacent to the main pipe connection. At the engine end the cast iron L at the top of the 5-foot drop is subjected to a transverse breaking strain equal to the resistance of the connection of the lower end multiplied by the leverage due to the length of drop. This strain is necessarily very great, as there is very little perceptible spring to so short a length of 5-inch pipe that it may be regarded as a practically rigid lever. As to the 5-inch angle valve at the lower end, as already mentioned, the effect indicates so severe a strain as to render imminent the danger of fracture of the cast iron body of the valve. In case of the fracture of any one of the parts designated the results would be of the most serious nature, as the escape of steam would be so rapid as to render it impossible for the attendants to do more than escape with their lives, and even of this much the chances would be decidedly slim. Of the subsequent effects, such as danger of explosion of the boilers from the siphoning action of the rapid decrease of pressure, it is unnecessary to speak further than to say that it would probably happen.

Referring again to the case under consideration, it was found, about a year since, that it was necessary to replace the old throttle by a new one, and the opportunity was then afforded of placing an expansion joint in the pipe. This was the ordinary form of commercial "slip joint," consisting of a brass sleeve and stuffing box, the latter being packed with asbestos wicking, laid up as hard as possible in an 8-strand square plait. It was located close to the L at the engine end, and the thrust due to the steam pressure on the drop was resisted by a connection to a heavy girder. This held the upper end of the drop rigidly in its original position and caused all movement in the pipe due to expansion and contraction to take place at the slip joint. Since this change was made all the difficulties and annoyances referred to have disappeared, the strains having been entirely removed. The movement of the slip joint afforded an accurate means of ascertaining the amount of expansion. This was carefully measured and found to be about $\frac{7}{8}$ inch, which, as the adjustment was made at a temperature of 60°, agrees very closely with the calculated elongation.

Most forms of expansion devices are comparatively inexpensive, and if properly applied their use will pay in the long run, even where they are not an actual necessity. As to which is the best form to select, there are, of course, many opinions, but there can be no mistake in using the slip joint if the work be done carefully. The asbestos packing is indestructible, and after it is once down to a good bearing will remain tight against leakage for years without any attention whatever. One great advantage of the device is that there is no interruption to the flow of steam, as the continuity of the pipe is unchanged. This is not the case with such forms as the long U bend, frequently employed, in which the friction due to four changes of direction sometimes detracts seriously from the efficiency of the steam.

Gaseous Fuel in the Retort House.

[Communicated to the London *Journal* by T. S. Cleminshaw, Assoc. Mem. Inst. C.E., of Launceston, Tasmania.]

In a paper presented at the last meeting of the Incorporated Gas Institute this setting was described at some length, but owing to the absence of a diagram it was naturally somewhat hard to understand the style of setting employed. Probably a more precise description of the arrangement will now be of interest, in so far as the setting and the foundations are concerned. The recounting of the facts will also be of assistance to others placed in a like position, and if such is the case the object of the present communication is fulfilled.

It would be wearisome to describe the various steps that led to the production of the accompanying style of generator furnace as well as the setting. From the drawing it will be seen that the arches of the settings are carried down to a depth of 10 feet 6 inches below the floor of the retort house. This depth was arrived at after mature study and experience; for the arches being narrow (7 feet 1 inch), did not permit of a wide furnace with the secondary air flues arranged as they appear. Nor would it have been feasible to repair the same, because the retorts above would have been endangered by removing their support.

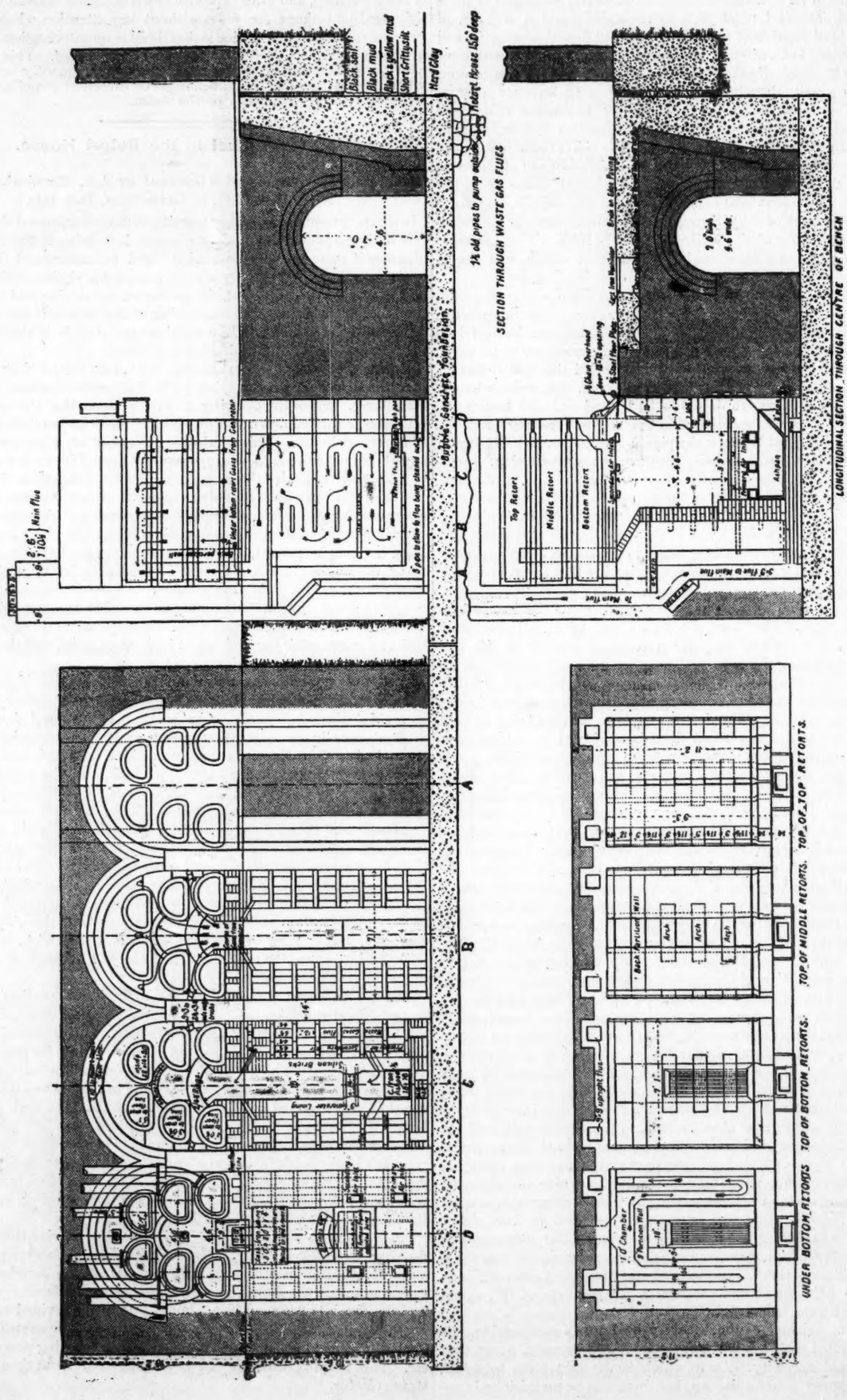
The first part of the work was to dig a sump 3 feet by 3 feet by 16 feet deep, in brick in cement, and allow for a permanent system of drainage under the walls of the retort house as well as the heavy retaining walls shown on the plan. This sump remains for use in keeping the foundations dry; and three or four times per day of 24 hours a 2-inch pump, worked about 10 minutes each time, keeps the water down. Pipes are laid under the retaining and the 14-inch cross walls, and the same plan is pursued with any extensions.

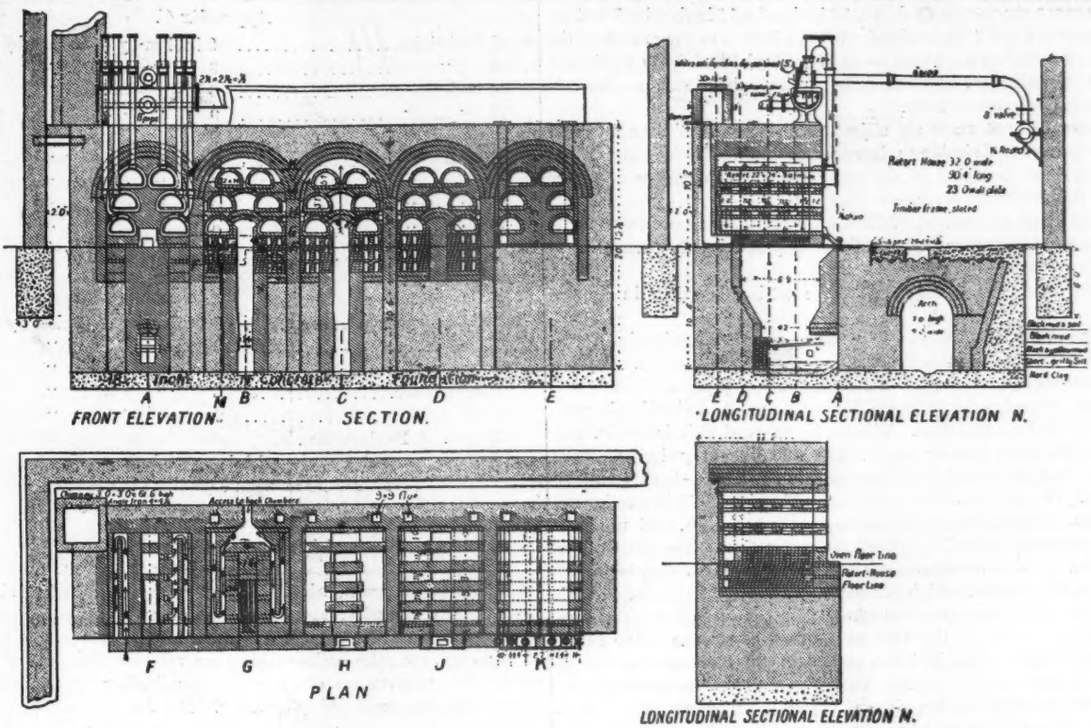
It will be seen on reference to the drawings that the old ground level was 6 feet below the present retort house, and 3 feet below high water in a tidal river 100 yards or so away. The ground demanded the greatest care in its excavation, being exceedingly treacherous. The timbering used for the main walls was 8 inch by 2 inch gum; the walings, at 4 feet spaces, being 9 inch by 3 inch, and the struts placed 5 feet 6 inch centers, and double at the ends of the walings. Four sets of these were used in sinking the walls. The heavy wall between the retort house and the coal store, 23 feet high to the wall-plate, was of anything but first-class work; and a large quantity of coal stacked 12 feet high in the store was an increased source of danger. The rubble foundation was used as a backing to place the runner against, and when the last set of walings was placed in the trench at the level of the top of the concrete (the runners being driven well into the clay below the concrete), the mixing of concrete was proceeded with, and tightly packed in to secure the timber. The timbers at the back of the retaining wall were not removed.

The concrete was composed of the following ingredients, to 3-inch gauge: Broken bricks, fire-bricks, retorts, 18 parts; clean, sharp quartz sand, 7 parts, and Portland cement, 2 parts. It was turned over twice dry; twice wet, and then tipped out of barrows into its place.

Large stones were placed in the concrete—3 inches intervening horizontally and vertically—and well rammed in; and when the first 1 foot 6 inches was reached the brick wall was built. At each 2 feet of its height the back was filled in, and large stones were left projecting to insure a bond for the next lot of concrete. Pockets 2 feet 3 inches wide were left in the brick facing to allow of the buttresses, and the 14-inch cross walls were continued afterwards. Care was taken that the brick work was not bulged outwards, temporary boards being used against the bricks as the work proceeded.

After the main wall was built high enough to receive the corrugated flooring, and racked off for extension, the cross walls were commenced and carried underneath the division walls of the benches about 18 inches to secure the fronts, and the intervening parts were excavated, and the concrete floor put in as shown. It was provided with a tramway for the removal of the ashes, and a gutter in the center to conduct the water overflowing from the furnaces or in washing down the floor, etc. This surplus water is led to a small sump, and then lifted by a steam ejector.


SECTION THROUGH WASTE GAS FLUES
LONGITUDINAL SECTION THROUGH CENTRE OF BENCH
UNDER BOTTOM RETORTS
TOP OF BOTTOM RETORTS.
TOP OF MIDDLE RETORTS.
TOP OF TOP RETORTS.
Top Retort
Middle Retort
Bottom Retort
Main Flue
Arch
Hop
Arch Partition Wall



A 14-inch wall was built under the ordinary front wall of the benches from the floor to the level of the flues in which the secondary air is heated, and a suitable opening was left in the center to receive the gases from the outside generator.

At first outside generators were employed. But the frightful heat of the cellar indicated a waste of fuel, so that, when the opportunity offered, the furnace was put inside the setting. The result was much less heat in the cellar and economy of fuel in the furnace.

At first the furnace was fitted up as a dry hearth, but the clinker and dust proved so troublesome that a change has been made to one with a wet hearth, with successful results, as the absence of clinker shows. Both water and steam are used, the water being led on the fuel under the arch, so as to damp the fuel and save the intense local heating that ensues in its absence. The steam is led below the bars, and the overflow of water is led away alongside the wall to the drain.

The sides of the generator are contracted, as shown, in order to prevent the primary air "short-circulating" up the walls of the generator, and thereby fluxing clinker and brick work.

The generator calls for slight mention, as it is open at the floor of the oven, 18 inches wide and 6 feet 9 inches long. The top part for six or eight courses is lined with silicon bricks and the remainder with Glenboig. A schedule of quantity of these bricks is appended, showing the approximate number required for the generator lining. The generator forms a work by itself. It is "straight-jointed" to facilitate repairs. The flues for the secondary air are covered with plain tiles, not rebated, and when the bench was let down for repairs after a run of 800 days' total life; the work was quite sound. The generator and flues are washed well with Purimachos cement previous to firing.

The style of setting is somewhat peculiar, and a description of it, with a reference to the drawing, will no doubt facilitate matters.

The oven being leveled up to the oven floor-line, the side (4½ inch) walls are run up their full height five courses of 2½ bricks level all through; also the midfeather wall, which stops 9 inches from the front wall. Then the back 4½-inch wall at the end of the retorts has a 4½-inch arch turned over the entrance of the back chamber (which entrance is for cleaning out the chamber). The 24 inch by 15 inch by 2½ inch tile on each side covers the space across the three 4½-inch walls and serves to protect the retorts at this part from falling into the flue. The 4½-inch wall adjoining the furnace wall is now carried up five courses at each end, but the center part only two courses, loose bricks being placed to enable the flat plates used in running in the retorts to be sustained.

The retort is now run in, and the joint made on the side of the oven and midfeather walls, the vacancy in the furnace wall being made use of for pointing up the bed on the midfeather wall so as to avoid short-circulating of the waste gases from inner to outer flues under the bottom retort. The 1½-inch space along the side of the oven and retort is now filled in (to the height shown) with broken bricks and fire-clay, and the end of the retort is served in like fashion if needed. The end and partition walls are next carried up to a height of 3½ inches above the bottom retorts. The furnace arches are now turned over, and saddles are placed and bedded *in situ*, and wedged at the side of the arch. The middle retorts are next run in, and bedded and wedged as shown, the upper furnace arches being turned and leveled off to receive the two top retorts. On these being placed, they are secured at the back end by the 4½-inch wall carried up so as to be level with the top of the retorts. The stays at the side of the retorts and between them (not shown) are then fixed, and the front wall is built in.

The portion of the front wall between the bottom and middle retorts is provided with a 4½-inch arch under the top retort mouthpieces, so as to facilitate repairs and save unnecessary blocking during that time. As the work proceeds, and previous to any retorts being put in, all flues are washed with white Purimachos cement, and subsequently all the retorts.

In repairing these settings it is usual to pull out the front wall, examine the arches, patch the retorts, and coat with Purimachos. If the top retorts require repairs, the front wall above them must be removed and the stays seen to, and patching then done where needful.

It will be noticed that the height of the floor of the top retort is 5 feet 1 inch above the floor of the oven, and this makes easy working for moderate-sized men. Ample flue-room has been found to exist between the retorts, though only 3½ inches intervenes between them. Many engineers claim 4½ to 5 inches as the proper space, in which case the top retort is unnecessarily high for scoops.

As to the course of the furnace gases, it may be remarked that the heat is gradually taken to the back, down the back chamber, and then split under the bottom retort to the front, round the midfeather wall to the back of the bench, and then to the upright flue to the main flue.

Very even results are attributed to this system of heating; also the absence, while working high heats, of blocked ascension-pipes. In many settings of sixes the bottom retorts are kept 4½ inches away from the side of the oven or smaller-sized retorts used, so as to make up the difference, the bottom and middle retorts being united by a 9-inch wall along the center. The furnace gases pass over the middles and tops, and gradually work to the inside of the front wall under the bottom retorts; then up the back chamber to a hole in the crown of the arch to the main flue.

Experience has shown this plan to be a fruitful source of blocked ascension pipes, as the hottest part of the retort is the front; and the gas from the coal loses any moisture in passing over this part, and blocks are the consequence. In the setting delineated, it will be seen that it is

feasible to place six retorts Ω-shape, 22 inches by 14 inches by 9 feet inside, in an arch 7 feet 1 inch wide by 7 feet 9 inches to the crown of the arch, and yet obtain good heats, so as to get a yield of 8,000 cubic feet of gas per mouthpiece, absence from choked pipes, and a moderate charge for materials and labor.

Where space is not such an object, in larger works than these, it would doubtless be advisable to have wider arches for seven retorts, and thus increase the width of the generator, so as to enable a poorer sample of fuel—such as breeze—to be utilized.

As to the size of the retorts, 22 inches by 14 inches seems quite small enough for a man to enter and comfortably patch up any cracks that may develop when let down.

A schedule of materials required in the setting is given in Appendix B.

A setting as described has just been taken out after having been under fire for 800 days, and this life it is hoped will be exceeded.

All the retorts are fitted with 5-inch ascension pipes and Tangyes' mouthpieces, 18 inches by 24 inches hydraulic main, and White's combined anti-dip valves and dips. The tar is removed as it is made, and the gas is taken away in a dry main. The valves employed give admirable results, and admit of very regular yields of gas—both quantity and quality. They are usually worked so as to give 1½-10ths suction on the dry main, increased to 2-10ths if the heats are high, and no difficulty is experienced in maintaining a steady suction. The governor is locally made, and is extremely sensitive. Any extra suction is on the outlet of the condensers, which consist of a hundred lengths of 12-inch pipes. These condensers are cleaned out yearly by turning on a fire-hose at the top of each of the two sections—the bye-pass valve being opened; and the tar salts, thick tar, etc., flow out through the 6-inch seal pipes. In case of more trouble than this the caps are removed and a set of three steel brushes are drawn through by means of a ½-inch iron chain. From this it will be seen that naphthaline is a stranger here.

Appendix A.

960	red bricks (stocks)	9 inches by	4½ inches by	3 inches.
1,500	Glenboig squares	9 "	4½ "	3 "
200	Cliff's silicon squares	9 "	4½ "	2½ "
15	Cliff's aluminous	9 "	4½ "	2 "
6	" "	9 "	4½ "	1½ "
60	" "	9 "	4½ "	1 "
42	" "	9 "	4½ "	½ "
60	Cliff's bevel ends, short.			
36	Glenboig tiles	18 "	11 "	2½ "
80	Cliff's aluminous arch	9 "	4½ "	2½–2 "
8	Glenboig squints	9 "	5 "	5 "

Furnace door and frame.
Primary and secondary air slides.
Bricklayer and labor, 160 hours each.
Concrete, about 4 cubic yards.

Appendix B.

6	Cliff's machine-made retorts.	22 in. by	14 in. by	9 ft. 3 in. over all.
800	Glenboig bricks	9 "	4½ "	2½ inches.
12	" "	9 "	4½ "	2 "
24	" "	9 "	4½ "	1½ "
48	" "	9 "	4½ "	1 "
30	" "	9 "	4½ "	½ "
45	Cliff's bricks, feather edge	9 "	4½ "	2½ "
24	" " "	9 "	4½ "	5 "
75	" silicon arch	9 "	4½ "	2½–2 "
120	" aluminous	9 "	4½ "	2½–2 "
40	" "	9 "	4½ "	2½–1 "
42	" bevel sides, long.			
35	" " medium.			
24	" " short.			
8	" aluminous saddle blocks.			
2	" " tiles	24 in. by	15 in. by	2½ inches.
22	" bevel ends, long.			
20	" " medium.			
12	" " short.			
22	" soap bricks	9 in. by	2½ in. by	2½ inches.
12	cwt. Cliff's fireclay.			
3	cwt. Purimachos, white.			
5	Glenboig sight holes	9 in. by	5 in. by	5 inches.
3	" " "	5 "	5 "	5 "

Bricklayer and labor, 152 hours each.

Appendix C.

5,800	firebricks	9 inches by	4½ inches by	2½ inches.
950	"	9 "	4½ "	3 "
90	arch bricks	9 "	4½ "	2½–2 "
12	" "	9 "	4½ "	2½–1½ "
30	" "	9 "	4½ "	2½–1 "
450	soap "	9 "	3½ "	2½ "
70	split "	9 "	4½ "	1 "
10	" "	9 "	4½ "	1½ "
40	" "	9 "	4½ "	½ "
40	flat edge	9 "	4½ "	2½ "
35	bevel ends.			
10	" sides.			
350	silicon squares	9 inches by	4½ inches by	2½ inches.
56	tiles	18 "	11 "	2½ "
12	"	24 "	15 "	2½ "
20	sight holes	5 "	5 "	5 "
8	" "	9 "	5 "	5 "

5½ cwt. of Purimachos.
Bricklayer and labor, 300 hours each.
Ironwork as usual, locally obtained.

Limes and Cements.

Charles D. Jameson, who occupies the Chair of Engineering in the Iowa State University, has prepared an exceedingly useful and reliable work on "Portland Cement," that is sure to be appreciated by builders of masonry, etc., the author taking the very sensible ground that good limes and cements are often rendered valueless by the inapt way in which they are employed in practice. Mr. Jameson says:

Take wood, stone or iron, for example. Provided a good quality has been selected, nothing the constructor can do will materially affect this quality. The material may be used injudiciously and uneconomically, but the ultimate strength remains the same. A square inch of steel will stand about the same tensile strain under all circumstances. With limes and cements, however, this is not the case. No matter how perfect the original quality of the cement may be, it may become absolutely worthless and a source of danger if not properly handled and applied after being received.

This fact makes it of the utmost importance that at least all engineers should be familiar with the manufacture, use and methods of testing limes and cements.

The engineer should be able to recognize a good cement when he gets it, and if it is not good, to indicate the probable reason of its failure, whether in the raw material, the method of making, or the treatment it received after the making.

Both lime and cement, when used for building purposes, are mixed with a certain amount of water and used in a more or less plastic condition. While in this plastic condition they are placed in the work in whatever position or form is required, and then this mixture hardens with more or less rapidity. This hardening is called setting, and it is this property of setting under different conditions that forms one of the radical differences between limes and cements.

Lime mortar will only set when exposed to the action of the air, and therefore can only be used in layers so thin that the air can penetrate to all parts of it. All parts of this lime mortar must not only be accessible to the air, but, to insure setting, the air must be dry.

Where lime mortar has been used in cellars that are damp, and in the plastering of houses exposed to the damp sea winds, its absorption of moisture has been so great that it never has become thoroughly set, and is always more or less damp and soft. With cement and cement mortar this is not the case.

A mixture of cement and water, properly made, will not only set in the open air, but will set when immersed in water or when in a vacuum. That is, contact with the air is not necessary in order that the process of setting may take place. In fact, not only is contact with the air not necessary for the setting of cement, but in order that the maximum results may be reached, all cement mortar should be kept either wet or immersed until it has become thoroughly set.

This may be considered as one of the most important rules governing the use of cement, viz.:

The quality of any cement work is very materially improved by keeping it wet during the process of setting. From this fact, that contact with the air is not necessary for the proper setting of cement, it is evident that there is almost no limit to the mass of cement mortar or concrete that can be used. No matter how massive the structure may

be, and no matter in what thickness the cement mortar or concrete may have been used, if the proper materials have been properly manipulated, this mass will set thoroughly throughout. Therefore, while lime can only be used in a dry location and in thin layers, cement can be used in any location and in any quantities.

Lime mortar under the best of circumstances has very little strength, either of adhesion or cohesion, while the best Portland cements properly used attain a strength superior to that of any of the building stones, with the exception of some granites, quartzites and trap.

The general differences between limes and cements, from an engineering standpoint, may be taken as lying in the fact that limes will set only in contact with dry air, while for the setting of cement, not only is the presence of the dry air not necessary, but the best results obtain when the cement is kept wet or immersed in water.

There can be no sharp line drawn between limes and cements, although there is no difficulty in distinguishing at sight between pure lime and good cements.

The ordinary lime of commerce consists of the calcined carbonate of lime in a state of greater or less purity.

The constituents of cement are carbonate of lime, silica and alumina with iron, with a few other ingredients of more or less importance. These three, carbonate of lime, silica and alumina, with iron, however, are the most important, and are always present in varying proportions. It is the relative proportions in which these constituents are mixed that make the resulting cement more or less hydraulic, that is, the power of setting under water, as the hydraulicity of the resulting compound varies as the percentage of the ingredients vary. We have cementing compounds from pure lime at one end of the list to Portland cement at the other. They can be divided into the following three classes: Lime, hydraulic lime, and cement.

Lime consists of practically pure carbonate of lime with less than 10 per cent. of impurities.

Hydraulic lime has mixed with the lime from 10 to 25 per cent. of silica, alumina and iron.

Cement contains:

Lime.....	55 to 65 per cent.
Silica.....	18 to 24 "
Alumina and iron.....	8 to 14 "

These usually amount to 94 or 96 per cent. of the whole. The balance may be made of magnesia, alkalies and sulphuric anhydride. These last are present in minute quantities, and although they undoubtedly have some influence upon the qualities of the cement, still this effect is very slight.

Lime.—Lime is made by the simple calcination of more or less pure carbonate of lime. This is found as limestone in all parts of the world. The calcination is done usually in a kiln. The fuel most commonly used is wood, but either soft coal or coke may be used. The method of charging the kiln is as follows: A rough, open arch is built of limestone above the bottom of the kiln. Upon this is placed a layer of fuel, then a layer of limestone, a layer of fuel, and so on, alternately, to the top of the kiln. The layers of fuel grow less as the top is approached. The fire is started at the bottom and the temperature gradually increases. As the fuel is consumed the limestone drops toward the bottom, and more fuel and limestone are added at the top. As rapidly as the limestone becomes sufficiently burned it is removed from the bottom of the kiln. It comes from the kiln in hard, white, rock-like pieces.

One peculiarity of the freshly burned lime is the great avidity it has for water, and, when it is exposed to moisture, the great amount of carbon it will absorb.

Lime that has not been exposed to moisture, and is in more or less the same condition in which it came from the kiln, is called quicklime. When this lime has been exposed to moisture in any shape, and allowed to absorb as much as possible, it is called slaked lime.

All lime, before being used, must be slaked. This can be done by drowning, sprinkling or exposure to the air.

Drowning.—The quicklime is spread out in a water-tight box and water added until it is completely covered. The entire amount of water needed should be put in at once. When the water is added the temperature rises, the mass effervesces, the quicklime increases rapidly in bulk, slowly disintegrates, and finally falls to pieces in a fine white powder, soluble in water. The impurities are separated from the lime. If additional water is added after the process of slaking has commenced, the temperature is lowered, and the slaking is not done as thoroughly as it otherwise would be. After the water has been added it is a good plan to cover the box so as to retain the heat as much as possible.

The increase in bulk due to slaking is 200 or 300 per cent. The lime, after the slaking is complete, is run off through an opening in one end of the box. It is about the consistency of very thick cream. The opening is covered with a grating or netting to prevent the passage of hard lumps, etc. The slaked lime is run either into another box or into an excavation in the ground, this second box or excavation being many times larger than the slaking box. The slaked lime soon becomes a stiff paste, and should be covered with sand or boards. It should not be used for mortar for a number of days, usually about ten, until it has become thoroughly cool.

Slaking by Sprinkling.—The quicklime is spread out in a layer 6 or 8 inches in thickness, and thoroughly sprinkled with water. It slowly disintegrates and falls into powder. There is no great increase in the temperature, and no effervescence takes place. One drawback to this method is the space and time required, which are both much greater than is required for drowning, and there is no reliable data to show that the lime thus slaked is in any way improved.

Air Slaking.—The lime is spread in layers 4 to 6 inches thick, and exposed to the air. It must be turned a number of times in order to insure thorough exposure to the air. The time and space required are both very great, and the gain, if any, small. Thoroughly slaked lime paste can be put up in airtight casks and kept without deteriorating for almost any length of time.

Hydraulic lime is made by the simple calcination of limestone that contains anywhere from 10 to 25 per cent. of the requisite impurities. The temperature required for calcination is but slightly higher than that needed for the burning of quicklime. The material must be slaked the same as quicklime before it can be used, and is reduced to powder in this way. No grinding machinery for reduction is used. The slaking is much slower than is the case with quicklime, and as the proportion of impurities increases it becomes slower and slower, until at last a point is reached where the resulting substance passes from hydraulic lime to natural cement. The reduction must be done by grinding, and the hydraulicity becomes a prominent charateristic.

Cement.—Cement as used in an engineering sense means such a combination of lime, silica, alumina and iron, that when properly calcined, reduced to powder, and gauged with a proper amount of water, has the property of setting under water and in places where it is not exposed to the action of the air. It also has the property of setting when in contact with the air.

For good results to obtain, the proportion of the requisite constituents must be within certain narrow and well defined limits. These proportions have already been given.

The cements used in building construction can be divided into two general classes, natural cement and artificial or Portland cements.

The term Portland cement means an artificial cement as distinguished from natural cement.

Natural Cements.—In many parts of this country and Europe there have been found immense deposits of impure limestone, that contain with more or less accuracy the necessary constituents for the making of cement. These constituents have been mixed by nature, and for cement making must be used in the proportions found.

The difference between the natural and Portland cements as to the raw materials used is this:

The desirable constituents in each are the same. In making natural cements, some impure limestone that contains as nearly as may be the correct proportions of lime, silica and alumina is used, and the value of the resulting cement depends upon the correctness with which nature has mixed these ingredients. It is found good, bad and indifferent.

With the raw material for Portland cement, however, nothing is left to chance. It is known, within certain narrow limits, what the constituents should be and in what proportions they should be present. This being known, such materials are used as contain these constituents in a more or less pure state, and then these comparatively pure raw materials are mechanically mixed in the correct proportions.

The mere fact that the raw materials are nearly perfect does not insure good cement, as the best of raw material may be rendered useless by improper burning or grinding. But, on the other hand, no good cement is possible unless the raw materials are good. Of course, any mechanical mixture of lime, silica, alumina, etc., within the limits named, will give good Portland cement if properly burned and ground. But in selecting raw material there is one other, most important question that must be considered, viz., that of cost.

In order to make a perfect mechanical mixture the materials must be reduced to an impalpable powder. The harder the materials, the more expensive this is; consequently, in selecting the raw material, the question of the cost of reduction must be considered.

The advantages of Portland cement over natural cement are two,

viz.: 1. The Portland cement is much better *per se*. The best natural cement never attains the hardness nor has the strength or durability of the most ordinary Portland. 2. Where proper care is used, Portland cement of any one brand possesses a uniformity of quality that can never be attained in the making of natural cement.

Examine almost any stone quarry, and the impossibility of obtaining a uniform quality of stone in any quantity will be seen at once. The quality of the stone varies in different parts of the quarry and in different layers of the stone, no two layers containing the same chemical constituents. As the stone is used in the condition in which it comes from the quarry, it will be seen that there will be an unavoidable variation in the quality of the resulting cements.

With Portland cement this is different. The raw materials are practically pure, and after experiments have given the proportions of mixing and the subsequent methods of treatment, there is no excuse for any irregularity in the results.

This uniformity in results is the one great point to be worked for in cement making. It can only be accomplished by the exercise of the greatest care in the selection and treatment of the raw materials. In the process of making there are some radical differences between natural and Portland cements. In the calcination the natural cements require a temperature but little above that required for lime burning, while the Portland cements require a temperature just short of that required for vitrification. The mixing, grinding, etc., all increase the cost of the Portland until at last the finished product brings about $3 per barrel on the market, while the natural cement sells for 50 cents.

True economy in the choice of cements consists in using the one best adapted for the work in hand. When the work is such as to justify the increased expense on account of required durability or strength, then the best Portlands should be used. But on less important work, or masonry of a cheaper character, the natural cements should be used. Nothing has done more to improve the character of all masonry work during the last 25 years than the cheapness and excellency of these light burned natural cements.

The Maximum Possible Efficiency of Galvanic Batteries.

Prof. Henry Morton, President of the Stevens Institute of Technology, contributes the following interesting matter on the greatest possible efficiency of galvanic batteries, to the June number of *Cassier's Magazine*. The President, as is usual with him in his presentation of any subject, speaks most concisely, and some of the pseudo-electricians, who are at present endeavoring to ensnare capital to the support of schemes looking to the development of cheap and unlimited power through the medium of galvanic batteries, will not thank him for his matter-of-fact utterances. The President says:

To discuss this question in an exact and numerical manner, it will be necessary to indicate with precision what class of batteries are referred to, and the writer would, therefore, say at the outset that he refers only to those which long experience has proved to be the most efficient in supplying large currents, excluding those of the Leclanché type, which yield only feeble currents.

In all the batteries here referred to there are the following common features: 1st, the energy is derived from the combination of zinc with dilute sulphuric acid; 2d, the supply of oxygen required for this combination is obtained by the decomposition of water or some other compound in aqueous solution. In other words, the batteries here considered are the Smee, the Daniell, the Grove and the various forms in which chromic acid is the oxygen-supplying substance.

This being premised, we can begin with the following general statement of principles: First.—The source of energy being the reaction between the metallic zinc and the dilute acid, its amount can be expressed in British thermal units as follows: Oxidation of zinc, 2,340 B.T.U.; solution of oxide in dilute sulphuric acid, 666 B.T.U.; or, in all, 3,006 B.T.U. as the total energy developed by the union of the zinc and acid. No arrangement of parts or employment of one material or another in other parts of the cell or for other parts of the reaction can add anything to this; but, on the other hand, there must always be more or less subtracted from it to meet the demands of the reaction, to say nothing of internal resistance of the solutions, local action, etc.

Second.—In order that the zinc should combine with the acid, the hydrogen, whose place it takes, must be driven out or otherwise taken care of, and this will demand an expenditure of energy, greater or less, but always considerable. For example, in the Smee battery the hydrogen is simply driven out in bubbles of gas. To do this requires 2,106 B.T.U. for each pound of zinc dissolved. Taking this from 3,006, leaves only 900 B.T.U. as even possibly available from each pound of zinc consumed in a Smee battery, not counting losses coming from local action, resistance, etc.

This difficulty was realized at an early period and was met by supplying oxygen to take up the hydrogen, and so avoid the great loss involved in expelling it. To supply this oxygen various substances have been used, but the only ones of practical importance are sulphate of copper, nitric acid and chromic acid. But even with these, more or less energy must be expended in decomposing them and securing their oxygen. The energies involved are:

	B.T.U.
Sulphate of copper, Daniell battery	1,587
Nitric acid, Grove or Bunsen battery	283.6
Chromic acid, Poggendorff battery	178.5

If these various amounts are subtracted from the maximum thermal value of the zinc-in-sulphuric-acid combination, we will have for the several batteries:

	B.T.U.
Smee battery, as before	900
Daniell battery	1,419
Grove or Bunsen battery	2,722.4
Poggendorff (chromic acid)	2,827.5

These figures represent the absolute maxima of energy which a pound of zinc could develop in these forms of battery, excluding all losses from resistance, etc. To get a practical view of these results, however, it will be necessary to reduce them to equivalent foot pounds of work and to horse power rates of doing work.

Joule has shown that each British thermal unit is equal to 772 foot pounds, and this means that the energy expressed by the heat which will raise 1 pound of water 1° F. (this is the British thermal unit) would lift 1 pound 772 feet, or 772 pounds 1 foot. If, then, we multiply the figures given above, we shall have the various energies expressed in foot pounds of work. In other words, a pound of zinc consumed in these various batteries would develop the following numbers of foot pounds, all losses from resistance, etc., being excluded:

Smee battery	694,800 foot pounds.
Daniell battery	1,095,468 "
Grove battery	2,101,694 "
Poggendorff battery	2,182,820 "

If, in each of these batteries 1 pound of zinc were consumed in a minute, then the above numbers of foot pounds would represent the work developed in a minute in each case, and to turn this into horse power we should divide each number by 33,000, because a horse power is a rate of doing work of 33,000 foot pounds each minute. This will give us the horse power represented by the solution of 1 pound of zinc each minute in each battery.

Smee battery	21.05 H. P. for one minute.
Daniell battery	33.19 " " "
Grove battery	63.66 " " "
Poggendorff battery	68.57 " " "

Such a rate of consuming zinc as a pound a minute would, of course, require an immense galvanic battery, and indeed it is usual to express the consumption of fuels generally in pounds per hour. To get the horse power due to the consumption of zinc at the rate of a pound an hour, we divide the above figures by 60, and this gives the horse power developed by a pound of zinc consumed during an hour as follows:

Smee battery	0.35, or about ⅓ H.P.
Daniell battery	0.55, " ½ "
Grove battery	1.06, " 1 "
Poggendorff battery	1.14, " 1⅛ "

This shows that in the best forms of battery an allowance of 1-horse power for each pound of zinc consumed per hour would be a liberal one, if something is allowed, as it must be, for the resistance, local action, etc. It may, however, be asked: If such an improvement has been made as above shown from the Smee battery giving one-third to the Poggendorff yielding 1⅛-horse power, may we not expect further improvements as great in amount? To this I answer certainly not in this class of batteries. The entire energy of the reaction between the zinc and dilute acid is 3,006 B.T.U. This would represent 2,320,632 foot pounds or 70.62-horse power for one minute, or 1.17, say 1⅛-horse power for one hour, and this would be an absolute maximum which could never be reached, far less exceeded.

Of course, if we could use some other and more efficient reaction than that between zinc and sulphuric acid, some gain might be secured, but nothing of that sort has ever been accomplished, nor from what is known of the combining or thermal equivalents of the available elements, is much to be expected in that line. At all events, we may well

accept this as a certain fact, that in any known form of galvanic battery the round figure of a pound of zinc per horse power per hour is an outside figure for efficiency, and when anyone asserts that more than this has been secured, there is certainly some mistake or fraud.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE officers of the newly incorporated Blue Island (Ills.) Gas Company are: President, Charles A. Rolfe; Secretary, Otis W. Bruner.

THE Cincinnati Gas Light and Coke Company has been granted a permit through the Buildings Inspection Department to erect a double structure on West Front street, between Rose and Park streets, which is to be used for the storage of coal and coke. One section of the house is to be 60 feet by 350 feet, while the dimension of the other is to be 60 feet by 100 feet; both to be two stories high. Iron and steel will enter largely into the construction, and the cost of the work is put at $30,000.

WE regret to report the death of Mrs. Gerge B. Neal, the estimable wife of Mr. George B. Neal, Treasurer and Agent of the Charlestown (Mass.) Gas and Electric Company. The circumstances attending her death were very distressing. Shortly after 10 A.M. of Sunday, June 9, Mrs. Neal left her home, No. 1 Monument square, in a carriage to attend the morning service in St. Johns Episcopal Church, Devens street, Mr. Neal and their daughter Clara having preceded her. On arriving at the church the driver noticed that Mrs. Neal was unable to alight, and her husband and daughter were notified of her alarming condition. The sufferer was immediately carried to her home, where death speedily followed. Rheumatism of the heart was the diagnosis of the physicians. She was a communicant of St. Johns Episcopal Church for 50 years, and she will long be remembered in Cambridge for her good works and her considerate and harmonious regard for others and respect for herself.

SOME time ago, at a regular Town meeting, the residents of Kingston, Mass., appointed a committee to "investigate the relative merits of gas and electricity as street lighting agents" for the public places of the town, and the committee seem to be wiser than such bodies usually are. Having made a superficial examination of the matter committed to them, they decided that it was a trifle beyond their ken, wherefore they asked (at a meeting held on the 15th inst.) the town to authorize them to incur any "fair expense arising from the employment of experts to enable them to submit an intelligent report." The town voted them the "fair fund" necessary for the carrying out of their purpose.

THE Messrs. Freese, true to their promise of some weeks ago, have completed the Albion (Mich.) gas plant before July 4th, for gas was turned on there on the evening of the 12th inst.

THE following are the sections of the proposed new city charter for Hartford, Conn., which relate to the gas supply pipes of the city:

"Section 1. Whenever the city of Hartford has in contemplation the paving of any street, alley or highway within said city, the Board of Street Commissioners, in addition to the powers conferred and duties imposed upon them by law, are hereby authorized and empowered to give notice to the residents, occupants and owners of property abutting upon said street, alley or highway, that the private gas supply pipes shall be laid, repaired, replaced or removed within a reasonable time, to be stated in said notice, and that thereafter, for not exceeding 10 years, no permits shall be granted, except by special vote of the Street Commissioners, for the opening of any street or highway for the laying, repairing, replacing or removal of any private gas supply pipe.

"Sec. 2. If any resident, occupant or owner of property neglects or refuses to repair or replace any dangerous or defective pipe, the Street Commissioners shall notify the Gas Company to cut off said supply pipe from its mains."

AT the annual meeting of the Norristown (Pa.) Gas Company the Directors chosen were: H. K. Weand, Jas. Boyd, H. C. Crawford, S. S. Kohn, I. H. Brendlinger, I. W. Smith, Jas. McGinnis, W. F. Solly, S. Gilbert, A. Wetzel, H. Boyd, Philip Quillman and H. C. Wentz.

THE American Gas Reduction Company, to manufacture, sell and rent automatic gas saving regulators in New York city, has been incorporated. It is capitalized in $250,000, and its Directors are: R. V. Schoonmaker, L. G. Friess and L. S. Friess, of New York, and J. B. Turner, of Elizabeth, N. J.

MR. G. W. BENEDICT has returned the 20-year lease of the Washington (Ia.) Gas and Electric Light Company, entered into by him some time ago, to the owners of the properties, the principal of whom is Mrs. N. Everson.

IT is reported that the Pekin (Ills.) Gas Company has absorbed the local electric lighting plant. Under the agreement the capital stock of the amalgamated concern is fixed at $120,000.

MR. C. B. WILSON has been appointed Superintendent of the municipal electric lighting plant, Hamilton, O. He is to take charge on July 1st, and his salary is to be $1,500 per annum.

THE Directors of Port Hope (Ont.) Gas Company have agreed to institute a rate for gas used for cooking purposes equal to $1.50 per 1,000 cubic feet, prompt payment to entitle the user to a rebate of 25 cents per 1,000. The Company agrees to sell cooking stoves, ranges, heaters, etc., at cost price. It was also determined to grant a further rebate of 10 cents per 1,000 from the net price on gas used for illuminating purposes, where the consumption is in excess of 20,000 cubic feet per year; the concession in the instance of an annual use of 50,000 cubic feet and over to be increased to 15 cents per 1,000.

GOVERNOR MORTON has ordered the State Inspector of Gas Meters (Mr. Anthony Clinchy) to answer within a specified time the charges made in the report of the special committee of the last Legislature that investigated the Inspector's conduct of his office. The report charges him with gross mismanagement thereof. The fact of the matter is Mr. Clinchy's post, with its $5,000 per annum salary, is needed for some regular reform Republican.

ENGINEER BARRET, of the Louisville, Ky., Gas Company, has agreed to furnish the suburb of Parkland with 19 arc lamps, on public lighting account, but he says it will not pay to extend the gas mains to the district, although there are at least 1,500 people in its boundaries. Hite is "high" on electricity.

THE following is the schedule of lengths and sizes of tubing, with number of burners determined on by the Hartford (Conn.) City Gas Light Company, to be followed by gasfitters in the piping of buildings for gas in the city of Hartford:

Size of Pipe.	Length Allowed.	Number of Burners.
½-inch	20 feet	6
¾ "	30 "	15
1 "	50 "	20
1¼ "	75 "	40
1½ "	120 "	60
2 "	160 "	100

THE Street Lighting Committee of the Oakland (Cal.) Council has recommended for acceptance the bid of the Oakland Gas Light and Heat Company for the public lighting of the city for the ensuing fiscal year. The figures are: For arcs, 2,000-candle power, moonlight schedule, 43 cents per arc per night; for gas lamps, 12½ cents per lamp per night, moonlight table. On nights when the moon should shine, but is obscured by clouds, fogs, etc., the Company is to light the gas lamps, on the order of the Chief of Police, the Company making a proportionate charge for the additional service.

AT the annual meeting of the Elgin (Ills.) American Gas Company the officers chosen were: Directors, E. H. McCullough, Lewis A. Riley, Thos. Leaming, Morris W. Stroud and Geo. G. Ramsdell; President, E. H. McCullough; Secretary and Treasurer, Morris W. Stroud; Gen. Manager, George G. Ramsdell; Supt., C. H. Dunbar.

THE Economical Gas Apparatus Construction Company, Limited, in addition to the contract recently entered into with the Blackburn corporation gas works, has arranged with the proprietors of the Colchester (England) Gas Company for the installation there of one of its improved carbureted water gas plants, up to a maximum daily capacity of 400,000 cubic feet, the apparatus being especially designed for the use of hot coke and heavy oils. The contractors are also to furnish special large boilers, engine and blower, elevator, iron floor, tar extractor, and a 60,000 gallon oil storage tank.

THE Hackensack (N. J.) Gas Light Company will lay a main under the Hackensack river for the purpose of supplying gas in the adjoining borough of Bogota.

THE following is a summary of the terms of the franchise which the Pawtucket (R. I.) Gas Company asks from the city authorities: The

city is to grant to the Pawtucket Gas Company the exclusive right for 20 years to lay, conduct and maintain pipes and conduits, and to erect poles and run wires and maintain the same from time to time, for the purpose of distributing gas and supplying electricity for lighting and heating with all necessary and convenient appurtenances as may be required for the conduct of the said business of the Pawtucket Gas Company in, over, along, through and under the streets and highways of the city, provided that the exclusive rights herein granted shall be construed to include the distribution of electrical power, when such power is to or shall be used for manufacturing or distributing electricity for lighting or heating, and to include the distribution of gas for power. For this franchise the Gas Company is to observe and perform all the conditions, limitations, obligations and restrictions imposed by the public laws; also, to pay into the city treasury a tax upon the gross earnings, in quarterly payments, at the rate of 1 per cent. per annum for the first 10 years, and at the rate of 1½ per cent. per annum for the second 10 years of said term—it is stated that at the present rate the city will receive about $1,500 per year. The Gas Company also agrees, in consideration of the renewal of the contract for street lighting for five years, from May 1, 1895, to change the 52 full arc lights to divided arc lights at a price $30 less per year, thereby saving the city $1,560 per year. Also, the Gas Company agrees that in all future contracts that may be made for supplying gas and electricity for the use of the city, the price or prices to be paid therefor by the city shall, in case of the failure to agree on the same, be determined by three competent and disinterested persons.

THE Connecticut Legislature has declined to sanction the application of the city of Norwich for the right to construct and operate a gas and electric lighting plant on municipal account.

THE Siemens-Halske Electric Company is negotiating for the absorption of the Mankato (Minn.) Gas and Electric Light Company and the Mankato Street Railway Company. A new Company is to be formed to operate the combined venture, the capital of which will not be less than $150,000 nor more than $200,000.

THE Gas Trustees and the Gas Committee of the Findlay (Ohio) City Council have referred the proposition for the establishment of an artificial gas plant in that city to the Common Council. Col. A. H. Moore is the backer of the proposed Gas Company.

AT a recent meeting of the Memphis (Tenn.) City Council the principal business transacted was the reception of the report of the Committee appointed to inquire into the proposed consolidation of the local Gas Companies. The report stated that the Companies submitted three propositions. Under the first they offered to furnish gas for public lamps at the price of $15 per lamp per annum; to supply gas to public buildings at $1.25 per 1,000 cubic feet, and to ordinary consumers, $1.75 per 1,000. The second proposition was to charge $20 for public lamps and to supply gas at a uniform rate of $1.75; the city to be paid 1 per cent. per annum of the Company's gross receipts. The third proposition was based on the grading of price according to the quantities of gas used by separate consumers, the proposition also containing the stipulation that when the output reached 200 millions cubic feet per annum an all-round rate of $1.50 was to rule. The Committee made the following final recommendation: "Your Committee would recommend as a basis of consolidation that the Company shall furnish gas to private consumers at $1.25 per 1,000 cubic feet; to the city for public buildings, at $1.25 per 1,000; for lighting street lamps, $1.25 per month per lamp, moonlight schedule; the gas to be of not less than 20 candle power; and that a suitable ordinance be passed and enforced for the inspection of meters for the protection of consumers. Also, that the works shall be located within the city limits." This ordinance is ridiculous, for the Companies could not live under the figures suggested.

AT a special meeting of the shareholders in the Citizens Gas Light Company and the Willimantic Electric Light Company, both of Willimantic, Conn., Mr. George E. Stiles was elected to the vacancy in the Board of Directors, caused by the death of Mr. O. H. K. Risley. Mr. Stiles was also elected Treasurer, and Mr. Edwin Evans was elected Secretary.

AT the annual meeting of the Exeter (N. H.) Gas Company the officers chosen were: Directors, Wm. Burlingame, Nathaniel Pierce, Edward Hatch, A. P. Browne and Odiorne Swain; President, William Burlingame; Treasurer, A. P. Browne; Clerk, A. F. Cooper.

THE suit of the Spring City Gas Light Company, of Royersford, Pa., against the Pennsylvania Railroad Company, for the taking of a strip of land belonging to plaintiff in Royersford, for a siding, has been settled by the payment from defendant to plaintiff of $4,500.

THE Parker-Russell Mining and Manufacturing Company reports an abundance of orders on its books for retorts; in fact, the business for the present season is a record. The increase in the price of oil is responsible for the unusual demand for retorts, and the Parker-Russell folks are busy making estimates for people proposing to put in coal gas plants or to rebuild their old benches. The Company is getting out the material for the 10 arches and 5 full-depth benches of 9's for the Atlanta, Ga., gas works, is figuring on several projected plants for full-depth recuperator, and has taken some large orders for its semi-recuperator benches, which have proved so very successful. The Company has completed the shipment of all arch blocks for 52 arches at the Cincinnati works, and is finishing up the shipment of retorts, settings and furnace blocks for 26 benches of 9's at that point. The Company is also furnishing the material for the Cleveland Gas Light and Coke Company; the Peoples Gas Light Company, of Cleveland; the Dayton (O.) Company, and the Companies at St. Paul and Minneapolis. Another notable shipment was the blocks for the 1,000,000 cubic foot capacity water gas plant now being constructed by the U. G. I. Company, at St. Paul.

THE new buildings to replace the part of the Parker-Russell Company's works destroyed by fire last March are about completed, and when the shops are finished it will have the most complete and perfect plant in the country for the manufacture of fireclay products. No expense has been spared in fitting up the works with the most improved machines and appliances. Electricity has been harnessed to furnish motive power for many of the lighter machines in different parts of the buildings distant from the engine. The power equipment includes a new Allis-Corliss engine, with a large boiler plant of surplus power. The floor plan of the main building, exclusive of the power house and adjacent sheds, cover over an acre of ground, and as it will be two stories in height there will be more than two acres of floor space for drying and other purposes. A very generous proportion of the building has been allotted to the department for the supply of gas works materials. The plant will have a normal and easy capacity of more than 5,000 retorts per annum, which can be increased to 8,000 without great strain. While the quality of the Parker-Russell Company's goods has always been acknowledged as excellent, increased facilities for quick work will enable it to take large orders for speedy delivery.

THE Hastings (Neb.) Council is attempting to revoke or annul the charter of the Hastings Gas Company, on the ground that the Company's service is very inefficient.

THE water gas set installed by the Western Gas Construction Company, of Fort Wayne, Ind., in the works of the Fort Wayne Gas Company, is yielding very satisfactory results, in that it is more than meeting the guarantee of its constructors.

THE Directors of the Conshohocken (Pa.) Gas and Water Company have declared a dividend of 3 per cent. on the preferred stock and 2½ per cent. on the common, payable since Monday last.

WE understand that Mr. William P. Knowles, formerly Gas Inspector for Richmond, Va., has succeeded the late Mr. W. C. Adams, as Superintent of the Richmond municipal gas works.

J. FRANK ALDRICH has applied to the City Council of Peoria, Ills., for a franchise for an opposition gas plant in that city. He proposes to manufacture and distribute either an 18-candle coal gas or a 22-candle water gas, at the gross rate, on illuminating account, of $1.25 per 1,000, the gross rate on fuel account to be $1 per 1,000. Payment within 10 days will entitle the user to a rebate of 25 cents per 1,000. He also agrees to furnish free of charge all gas needed for the illumination of the City Hall building. He is also to "lay all lateral service pipe connections between the gas main in the street and the lot line abutting thereon, with all necessary stops or cut-offs at own expense."

THE laborers employed on the tank for the new gasholder that is being constructed by the Cleveland Gas Light and Coke Company struck for an increase in wages and were dismissed. After four days of enforced idleness they applied for rehiring at the old rate, but their places had been given to others.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

MONDAY, JUNE 24, 1895.

Coke as a Locomotive Fuel.

Mr. G. B. Hazlehurst, General Superintendent of Motive Power for the Baltimore and Ohio Railroad, reports that satisfactory results have been obtained by the use of coke as a fuel in fast express service. In 1884 the first experiments were made in this direction when coke was used on the fast express trains between Washington and Philadelphia. Coke produces practically no smoke, but it gives out a penetrating gas under certain conditions of draft and air supply. A great deal of difficulty was found at first in educating the men to fire this fuel properly, and it is reported that only after about a year and a half did they acquire sufficient experience to handle it without difficulty. A coke fire requires special care and far more attention than one of coal, and on this account the fuel does not find much favor with firemen, who, as a rule, dislike it.

In the fire, coke gives a very intense local heat and must be fired heavily. The green coke is massed at the door and gradually worked forward into the fire. No deleterious effects are found in the use of coke as to action on the fireboxes even after a continued experience covering five years, which is ample time for a perfectly satisfactory trial.

Some difficulty has been experienced on account of a deposit of solid matter from the coke which limits the length of the run with this fuel to about 100 miles. The deposit is formed on the flue sheets and also on the netting in the front end, and at the end of about the distance stated this becomes sufficient in amount to interfere with the draft and the steaming of the engine unless handled with great care. As to its efficiency as a fuel, it is reported that about 10 per cent. better evaporative results may be obtained from coke than from an equal weight of bituminous coal such as is used on the Balti more and Ohio Railroad. There is a great difference in the volumes of coal and coke, weight for weight, which necessitates the construction of special racks upon the tenders in order to carry sufficient fuel for long runs. The average cost of coal on four divisions in 1894 was $1.09, and the average cost of coke for the same divisions was $1.85, which gives a general idea of the relative costs of the two fuels. This ratio, however, is somewhat affected by the cost of hauling from the mines and ovens. In spite of the fact that better results are obtained from coke than from equal weights of coal, the former remains a very much more expensive fuel and its use will probably be determined only by such factors as comfort of passengers and freedom from smoke in large cities. It is the practice on the Baltimore and Ohio Railroad to mix some coal with the coke in the proportion of about one-tenth of coal to nine-tenths of coke. This is done in places where coke alone can not be used, and the smoke produced is in proportion to the ratio of coal to coke. It may be said that the results of the use of coke are fairly good from a standpoint of economical working, yet it is unquestionable that the reason for its employment is merely that of the comfort of patrons of the roads and the reduction of smoke fines.

Coal Production of the World.

According to the latest reports upon the coal industry, England is the largest producer in the world, her output during 1894 having been 188,277,525 tons. This was mined by 705,244 persons. The United States comes second in the list, with 164,000,000 tons. Germany produced during the same year about 73,000,000 tons, exclusive of lignite. The other coal producing countries mine practically the same amount from year to year, as follows: Austria-Hungary, 10,700,000 tons; France and Russia, 6,250,000 tons each; Australasia, 4,000,000; Japan, 3,250,000; Nova Scotia, 2,250,000; Spain, 1,300,000; British Columbia, 1,200,000; Italy, 300,000; Sweden, 200,000.

The consumption of coal per head of population is lowest in Austria, where it is only one-sixth ton per annum, and highest in Great Britain, where each person averages $3\frac{3}{5}$ tons each year. In the United States the average is $2\frac{1}{4}$ tons a year.

The Market for Gas Securities.

The market for city shares was quite ragged during the week, the tendency in all shares being towards lower prices save in the instance of Standard, both common and preferred, the former advancing to 69 bid. We incline to the view that this is about high water mark in it for the present, although it is undeniable that all signs fail in a market like the one now ruling. Consolidated sold down to 144 in the week, and it is listless to-day at 145 to 146. Equitable holds at about 200, and Mutual is nominally returned at 170 bid. Our advice is to go slow in the purchase of city shares just now, and the same hint goes in respect of Brooklyn stocks, the nominal quotations for which remain unchanged. It is in the cards that there may be somewhat of a rumpus in the Brooklyn situation before long. The feature in out-of-town shares continues to be Consumers, of Jersey City, which is 85 bid. There is no doubt on earth that it will reach the par mark before January 1st. Detroit bonds continue to climb. Chicago gas is fairly steady, and Lacledes are weaker.

Gas Stocks.

Quotations by Close & Nash, Brokers and Dealers in Gas Stocks.

35 Wall St., New York City.

June 24.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$25,430,000	100	145	146
Central	500,000	50	140	..
" Scrip	220,000	..	100	..
Equitable	4,000,000	100	199	201
Bonds, 6's	1,000,000	1,000	104	..
" 1st Con. 5's	2,300,000	1,000	111½	..
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	170	..
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	..	..	.
Northern	150,000	50	90	91
" Bonds	150,000	1,000	..	98
New York and East River	5,000,000	100	30½	31¾
Preferred	2,000,000	100	55	57
Bonds	3,500,000	1,000	95¾	96¼
Richmond Co., S. I.	348,650	50	50	..
" Bonds	100,000	..	..	..
Standard	5,000,000	100	69	70
Preferred	5,000,000	100	109	111
Bonds, 1st Mortgage, 5's	1,500,000	..	105	..
Yonkers	.....	50	101x	.
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	125	..
Citizens	1,200,000	20	65	..
" S. F. Bonds	320,000	1,000	..	101
Equity	2,000,000	10	..	..
" Bonds	1,000,000	..	..	..
Fulton-Municipal	3,000,000	100	175	..
" Bonds	300,000	..	103	..
Peoples	1,000,000	10	90	.
" Bonds, 7's	308,000	..	100	..
" " 6's	94,000	..	98	100
Metropolitan	870,000	100	170	..
" Bonds, 5's	70,000	..	..	..
Nassau	1,000,000	25	225	..
" Ctfs.	700,000	1,000	99	100
Williamsburgh	1,000,000	50	210	..
" Bonds	1,000,000	..	107	110
Out-of-Town Companies.				
Bay State	5,000,000	15	22	23
" Income Bonds	2,000,000	1,000	33	36
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	80	..
2d " " " "	3,000,000	1,000	55	57
Buffalo Mutual	750,000	100	120	..
" Bonds	200,000	1,000	95	100
Chicago Gas Co.	25,000,000	100	74	74½
Chicago Gas Lt. & Coke Co. Guaranteed Gold Bonds.	7,650,000	1,000	93	93½
Columbus	1,060,000	..	..	..
1st Mortgage	1,085,000	..	..	..
Consumers, Jersey City	2,000,000	100	85	90
" Bonds	600,000	1,000	100	..
Cincinnati G. & C. Co.	7,000,000	100	206	..
Consumers, Toronto	1,600,000	50	184½	187
Central, San Francisco	.....	..	90	100
Capital, Sacramento	.....	.	..	50
Consolidated, Baltimore	11,000,000	100	63¾	64¼
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490,000	..	..	..
Detroit	4,000,000	..	29	31
" Con. Bonds	4,812,000	..	69	70
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	73¼	75
" Bonds	2,000,000	..	84⅜	85¼
Hartford	750,000	25	120	128
Indianapolis	2,000,000	..	150	..
" Bonds, 6's	2,650,000	..	104	..
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind	1,000,000	100	85	86
Bonds	1,000,000	1,000	86½	87½
Louisville	2,570,000	50	.	130
Laclede, St. Louis	7,500,000	100	28	28¼
Preferred	2,500,000	100	85	86
Bonds	9,084,400	1,000	97	97⅜
Little Falls, N. Y.	50,000	100	..	100
Bonds	25,000	..	..	100
Montreal, Canada	2,000,000	100	200	..
New Haven	.....	25	225	..
Oakland, Cal.	.....	..	42⅝	43
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	2,100,000	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	..	175
Paterson, N. J.	.....	25	90	102
Rochester Gas & Elec. Co.	2,150,000	50	..	..
Preferred	2,150,000	50	81	..
Consolidated 5's	2,000,000	..	87½	90
Syracuse, N. Y.	500,000	25	..	..
San Francisco, Cal.	10,000,000	100	72⅝	73¾
Washington, D. C.	2,000,000	20	250	..
Western, Milwaukee	4,000,000	100	64	66
Bonds, 5's	3,556,000	..	93½	93½
Wilmington, Del.	500,000	50	188	190

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Isbell-Porter Co., New York City..... 954
The Western Gas Construction Co., Fort Wayne, Ind.... 946

ELECTRICAL APPARATUS.

Wm. Henry White, New York City..... 955

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Otto Gas Engine Works, Phila., Pa..... 960
The American Gas Engine Co., Phila., Pa..... 938

PURIFIER SCREENS.

John Cabot, New York City..... 937

GAS STOVES.

American Meter Co., New York and Philadelphia..... 943
The Goodwin Meter Co., Phila., Pa..... 958
George M. Clark & Co., Chicago, Ills..... 941
Maryland Meter and Manufacturing Co., Baltimore, Md.. 958
The Schneider & Trenkamp Co., Cleveland, O..... 940
William M. Crane & Co., New York City..... 941
Keystone Meter Co., Royersford, Pa..... 937

CHINA GAS KILNS.

F. A. Wilke, Richmond, Ind..... 956
William M. Crane & Co., New York City 941

GAS FLOW COMPUTERS.

Wm. Cox, Stapleton, N. Y..... 953

COIN WRAPPERS.

Alvord & Co., Detroit, Mich..... 816

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J. P. Whittier, Brooklyn, N. Y..... 951

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Kerr Murray Mfg. Co., Fort Wayne, Ind..... 952
Stacey Mfg. Co., Cincinnati, Ohio. 955
R. D. Wood & Co., Philadelphia, Pa..... 954

Wanted.

The Town of Westmount, Canada, desires to obtain the services of a

Consulting Gas Engineer

as to the establishing of a Gas Plant in the Town. Applications may be addressed to

WM. MINTO, Sec.-Treas.,
Westmount, Montreal, Can.

DIVIDEND NOTICE.

OFFICE OF WELSBACH LIGHT CO.,
DREXEL BUILDING, PHILA., June 12, 1895.

The Directors have this day declared a dividend of twenty (20) per cent., payable on June 29, 1895, to stockholders of record at the close of business June 21. Checks will be mailed.

N. B.—The transfer books close from June 21 to July 13 for the annual meeting.

1045-2 EDWARD C. LEE, Treasurer.

WANTED,

A Competent Gas Superintendent

For a new Coal and Oil Gas Works in a rapidly increasing Northwest city, centrally located. Must have capital to take an interest in same, and entire management on salary. Or will sell controlling interest. Address "E.," Room 1540,

1044-3 Marquette Building, Chicago, Ills.

POSITION WANTED

As Manager of a Gas Works or Gas and Electric Light Works.

Has successfully managed Gas and Electric Light Plants for the past five years.

1043-tf Address "G. & E.," care this Journal.

WANTED,

By a man who has had a round experience in the manufacture and sale of gas,

A Position as Supt. of a Large or Small Gas Works.

Is capable and energetic, and is willing to begin at a moderate salary. Address

1032-tf "B.," care this Journal.

WANTED,

Second-Hand 6-Foot Station Meter.

Must be in good condition and cheap. Address "GAS," 80 Moffat Block,

1045-3 Detroit, Mich.

FOR SALE,

Two Second-Hand Purifiers,

10 ft. by 15 ft. by 3 ft., 24-inch Cups, with Center Seal and Connections, all in good condition. Address

1086-tf "PURIFIER," care this Journal.

A Profitable Investment.

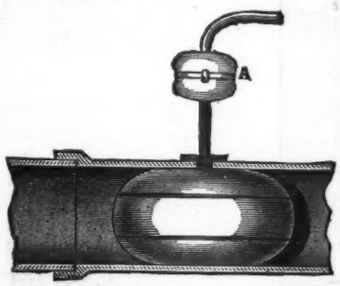
SELL OUR UNEQUALLED

Mica Canopies and Chimnies. . .

Prices Sure to Suit.

THE MICA MFG. CO.,
88 Fulton St., N.Y. City.

Peerless Patent Improved Gas Bag



These Gas Bags are used to stop the flow of gas while repairing or making alterations in gas mains. There have been numerous cases of workmen being badly injured, and sometimes fatally, by the escape of gas resulting from the bursting of a bag, and our patent improvement is designed to obviate such calamities. The indicator *A* shows unerringly when the bag has been sufficiently inflated to pack the main, and when the pumping should be stopped. Our Bags are made of a rubber stock especially prepared to admit of great distension, and to resist the action of Oils, Gases, Naphtha and other residuum in the mains, and they are made with lapped joints, which adds greatly to their strength.

3-in.	Gas Bag,	each,	$0.60	12-in.	Gas Bag,	each,	$5.00
4	"	"	.80	16	"	"	8.25
5	"	"	1.05	20	"	"	12.00
6	"	"	1.75	24	"	"	17.00
8	"	"	2.65	30	"	"	27.50
10	"	"	3.75				

The Peerless Rubber Mfg. Co.,
16 Warren St., N. Y. City.

If You Want the Best GAS-TIGHT Tubing,

BUY OF THE

NEW YORK GAS TUBING CO.
334 & 336 East 23d St., N. Y.

GUARANTEED NOT TO STIFFEN. Makers of All Kinds of Flexible Tubing.

Utilize Your Gas Liquor.
NO EXTRA LABOR OR OPERATING EXPENSES.

Ammonia Concentrator.

Not Expensive. Write to
STROH & OSIUS, Pat'ees, or
Mich. Ammonia Works, Detroit, Mich.

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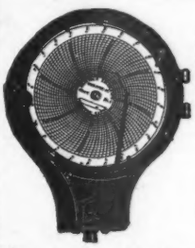


For Continuous Records of

Street Gas Pressure.

Simple in Construction,
Accurate in Operation,
Low in Price,
Fully Guaranteed.

Send for Circulars.

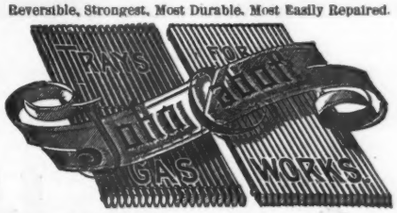
THE BRISTOL CO.
Waterbury, Conn.

Received Medal at World's Columbian Exposition.

Special Trays for Iron Sponge or Oxide of Iron.

CHURCH'S TRAYS a Specialty.

Reversible, Strongest, Most Durable, Most Easily Repaired.



506-310 Eleventh Avenue, New York.

We also make the Cheapest and Strongest
REVERSIBLE BOLTED TRAYS IN THE MARKET
Send for Circulars.

MOSES G. WILDER,

Mechanical Engineer,

816-822 Cherry St., Phila., Pa.

MANUFACTURER OF

Gas Governors,
Governor Gas Burners,
Gas Cocks and Fittings,

In addition to a full assortment of Volumetric Governors, etc., I am now making **MERCURY PRESSURE GOVERNORS** of all the usual sizes, adapted to use upon *Gas Stoves, Furnaces, and Meters.* The same careful attention to details of design and workmanship which has established the reputation of **WILDER'S VOLUMETRIC GOVERNORS** will be given to the new line. They have been thoroughly tested in many places during the past year, and have given entire satisfaction. The price is very low, and but for a complete system of machinery adapted to this work, it would be impossible to sell them at the price. I hope for large orders, as they become known, in consequence of the low price and good quality.

Patent Lava Gas Tips.

UNIFORMITY GUARANTEED.

ALL SIZES AND SHAPES.

D. M. STEWARD MFG. CO.,
CHATTANOOGA, TENN.

The Celebrated SHANER GAS COAL

CORRESPONDENCE SOLICITED.

Is Mined and Shipped from the Best Gas Coal Basin in Pennsylvania.

SHANER COAL CO., - 1326 Chestnut Street, Philadelphia.

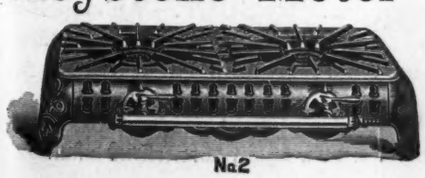
No. 1

The Burner's Better . . . . .

That's one thing. It is a patent of our own, and a '95 burner in all respects. Then the perfect combustion, resultant from a new system of air mixing so simple of adjustment that your customer understands it at first glance, helps largely to make the **IRVING** so popular. Its elegance produces universal comment. It's hard to impress these things—they sound like stock phrases. Seeing the stove brings conviction. And after all, the price is the most captivating argument. If you believe a dollar saved is a dollar earned, and want to make that dollar, write us at once.

Keystone Meter Co.,

Royersford, Pa.



No. 2

No. 3

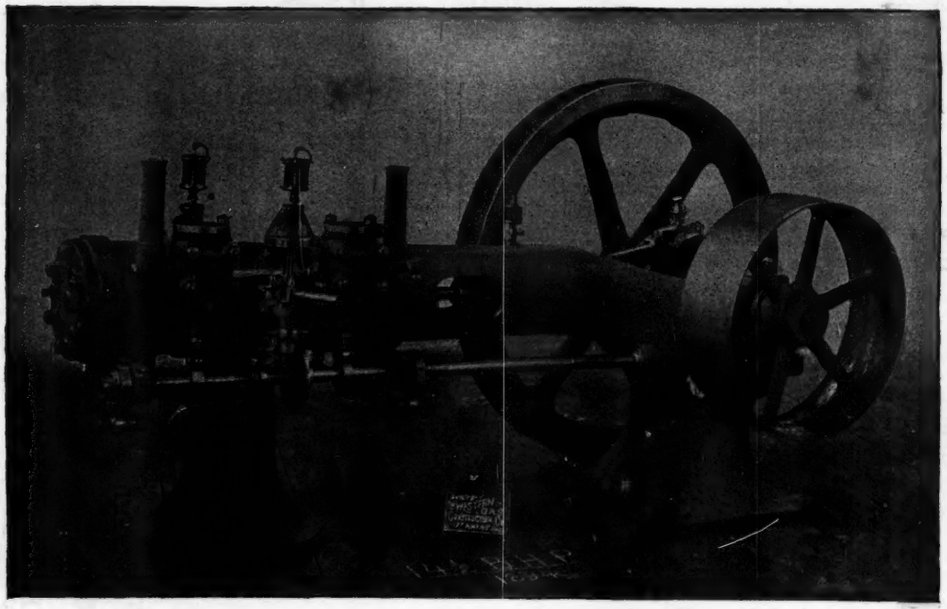
WM. W. GOODWIN, Prest. O. N. GULDLIN, V.-Prest. & Treas. H. B. GOODWIN, Sec. EARNEST F. LLOYD, Asst. Sec

THE AMERICAN GAS ENGINE CO.,

MANUFACTURERS OF

The Double-Acting Gas Engine,

Under the Patents of Griffin, and Dick, Kerr & Co., of London and Kilmarnock.



⁂

Single Cylinder.

Impulse Every Revolution.

(Two Strokes.)

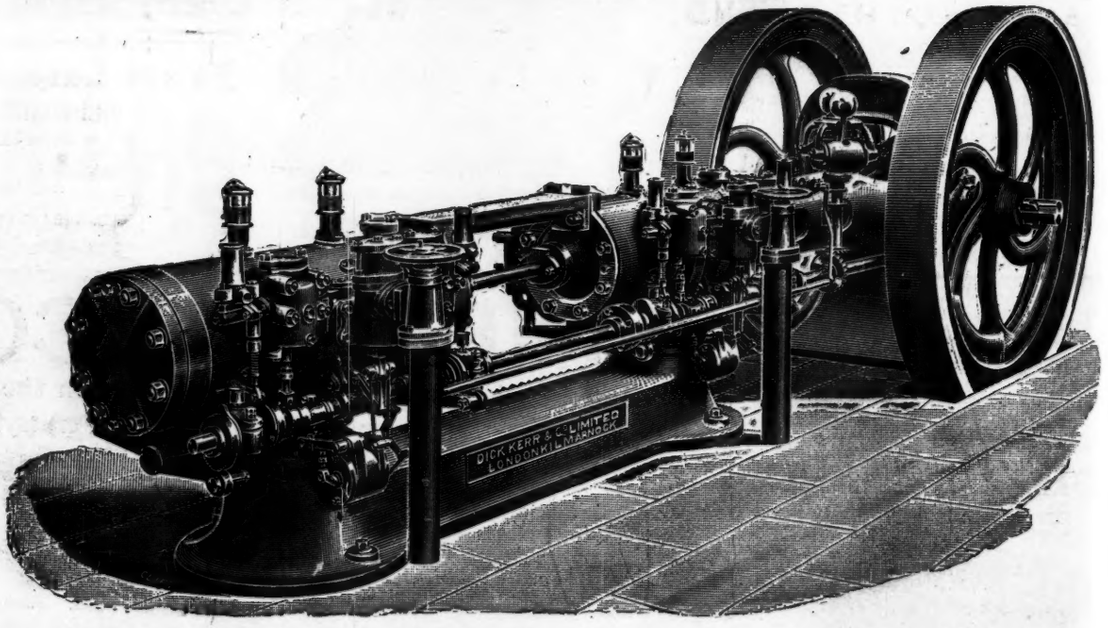
15 to 500 Horse Power.

For General Work and Isolated Electric Plants.

⁂

Tandem Cylinder. Impulse Every Stroke. 100 to 1,000 Horse Power.

For Central Stations and all work requiring extreme steadiness.



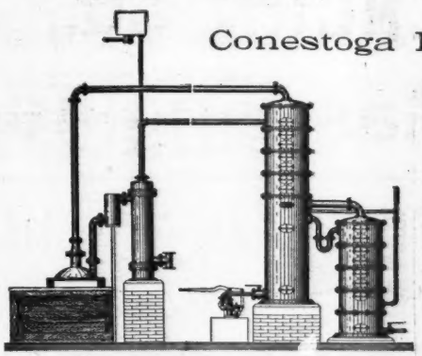
ESSENTIAL PRINCIPLE.—An impulse at each end of piston; using half force to each impulse; doubling the steadiness; reducing the wear on moving parts, and weight for given power. **CONSTRUCTION.**—The piston rod works through stuffing box in front end of cylinder, and connecting rod is carried in a cross-head working in a slide in frame, as in ordinary steam engine practice. All valves are of the poppet type, operated by cams on a single cam-shaft, giving positive movement to every working part. Tube or electric ignition. **RESULT.**—An engine of extreme simplicity and steadiness of action, the even wear on the cylinder and all working parts assuring increased economy, long life, and minimum cost in repairs. **RECORD.**—Successful and constant use in Great Britain for the past eight years. Address

W. W. GOODWIN, President, Lock Box 718, Philadelphia, Pa., or
THE WESTERN GAS CONSTRUCTION CO. Bldrs. & Gen. Agts., Fort Wayne Ind.

GAS ENGINEERING COMPANY,

INCORPORATED,

Conestoga Building, PITTSBURGH, PA.



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MANUFACTURERS OF

Gas Works Machinery of all kinds,

PATENTEE AND OWNER OF

PITTSBURGH WASHER-SCRUBBER,

SOLE AGENT FOR

FELDMANN AMMONIA MACHINE,

For producing Sulphate, Aqua, Chloride and Concentrated Liquors.

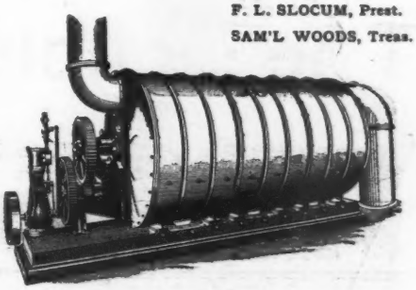
The Erection of Bi-Product Coke Ovens a Specialty.

Faux System of Recuperative Benches,

JAS. GARDNER, JR.
SOLE CONSTRUCTOR AND BUILDER.

NEW SYSTEM HYDRAULIC MAIN.

F. L. SLOCUM, Prest.
SAM'L WOODS, Treas.



SCRUBBER.

THE LITTLE GIANT (AN IMPROVEMENT ON THE LOWE) GENERATOR.

Can be put into Coal Gas Works at a price the interest on which will not be so much as their present repair account.

This Generator is now in use in nearly every State in the Union, and everyone using it will recommend it to you.

It makes a faultless gas from whatever gas-producing materials are cheapest in the locality where required, using hard coal or coke in connection with Lima crude or any other crude petroleum or its distillates, including *Naphtha of any specific gravity.*

I build these Generators with any required capacity, from 3,000 cubic feet per hour upward.

In more than one half the gas works in the country the "Little Giant" will enable *one man* to easily make, in *five hours*, all the gas needed for the *twenty-four hours.*

Why struggle day and night, year after year, with high priced, low candle Coal Gas; with choked standpipes, broken retorts, naphthaline, and interminable other troubles and delays, while it is so easy to make an entirely better gas for less money in a quarter of the time, and having none of these drawbacks?

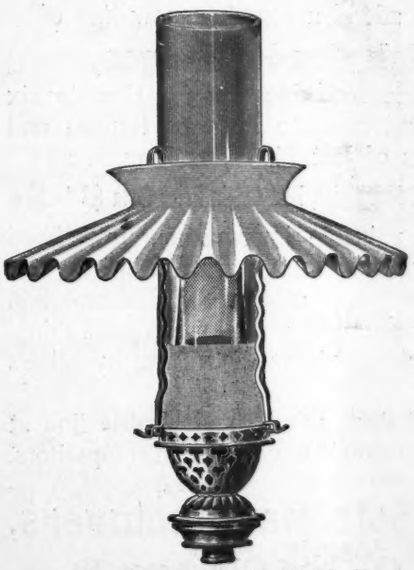
If gas coal is very cheap and anthracite coal and hard coke very expensive with you, put in a Little Giant Generator, as many others have done, *to increase candle power, to use up your surplus coke, and to rush up your holder when hard pressed.*

All work and results guaranteed.

A. M. SUTHERLAND, - - - No. 136 Liberty Street, N. Y. City.

The Improved

Welsbach Light.



No. 31 Burner, with No. 74 Shade.

No. 31 Burner, with Nos. 10 and 43 Shades.

ade by the

Welsbach Light Company,

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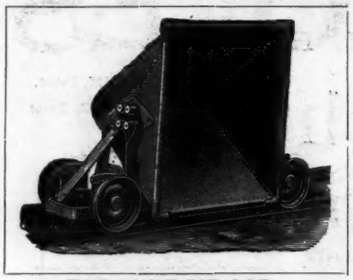
Sole Manufacturers for the United States.

G. W. HUNT COMPANY.



THE HUNT TIP CAR.

COKE CARS for Gas Works,
TIP CARS for Carrying Ashes,
CHARGING CARS for Bringing Coal from the Storage Bins to Boiler Room and Retort Houses.

INDUSTRIAL RAILWAYS

Specially designed for handling material in and around

Gas Works, Coal Yards, Factories, Etc, Etc.

45 BROADWAY, - - NEW YORK.

F. BEHREND,

SOLE IMPORTER OF THE CELEBRATED

German (Stettin-Didier) Clay Gas Retorts,

BLOCKS, TILES, FIREBRICKS, FIRE CEMENT,

Stettin "Anchor" & "Eagle" Brand Portland Cement

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Read, Holliday & Sons, Ltd.

No. 7 Platt St., N. Y. City.

HYDRATED OXIDE OF IRON

For Gas Purification.

Analysis, Samples and Particulars on Application.

NEWBIGGING'S HANDBOOK FOR GAS ENGINEERS AND MANAGERS.

The present (the fifth) edition marks an important advance on those that have gone before. Considerable additions have been made to the text and much of it has been rewritten and otherwise improved.

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RELIABLE GAS STOVES AND RANGES

By all odds the most Complete Line manufactured under one name, comprising all known Styles and Sizes.

More desirable improvements made in the **Reliable** line for 1895 than in all makes combined for the past ten years.

In addition to the many improvements, we have also added a complete new line of

High Grade Ranges,

swelling the **Reliable** line for 1895 to six distinct and separate lines of Ranges and three lines of Hot Plates, making in all

126 Sizes and 252 Styles, Ranging in Price form $2 to $84.

All the valuable improvements we have added for the coming season will give the **"Reliable"** a prestige as the leading line of Gas Ranges, and, being such a good thing, will undoubtedly be pushed along by others in 1896.

You will always find the **Reliable** line at least three years in advance of all competitors.

THE SCHNEIDER & TRENKAMP COMPANY, Sole Manufacturers,

Send for our 1895 Gas Catalogue. It cannot fail to Interest you.

Cleveland, O., and Chicago, Ill.

JEWEL GAS STOVES

This is One of Eight New Ranges.

For 1895

ARE MODERN

AND

UP TO DATE.

Two New Laundry Stoves.

Six New Square Junior Stoves.

WRITE FOR 1895 CATALOG.

56 Cooking Appliances.
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WILLIAM M. CRANE & CO.,

Office, 838 Broadway.
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We carry the Most
Complete Line of
Gas Appliances in the
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Gas Fires, Gas Logs,
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Tailor Stoves,
Soldering Furnaces,
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A Complete New Line
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Send for Description of our NEW VULCAN Gas Furnace, for HOT AIR or HOT WATER.

Gas Controllers, Meter and Service Cocks, Independent and Hose Cocks, and Fittings of all kinds, with Extra Large Gas Way.

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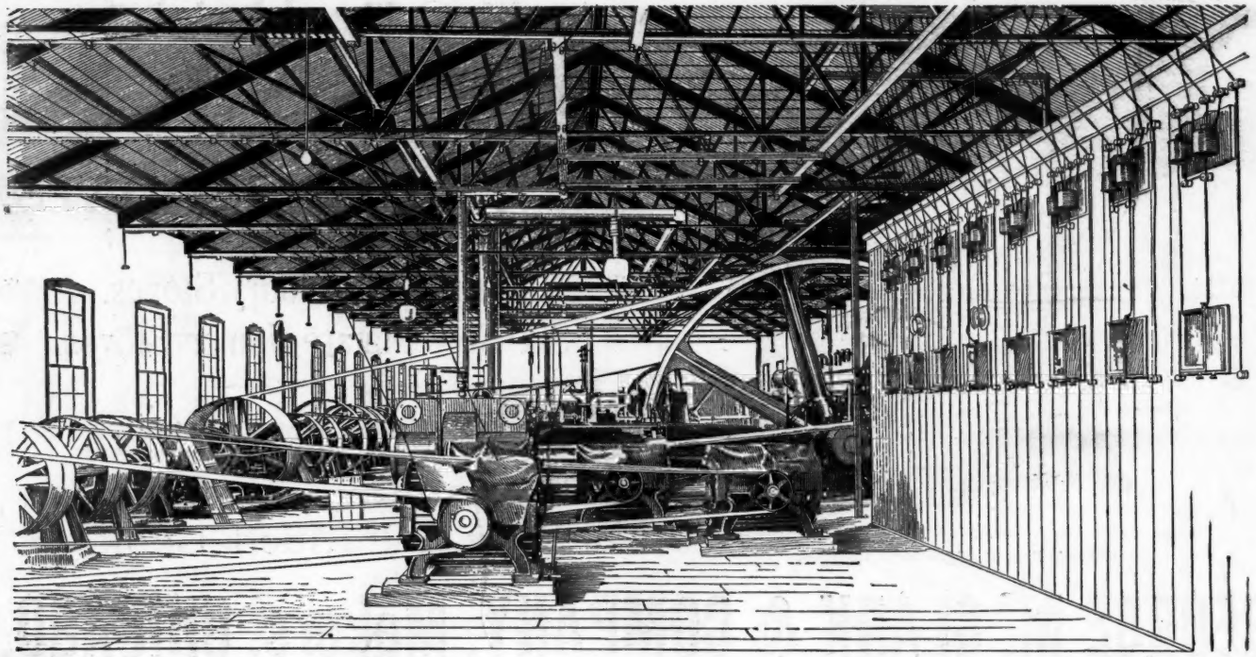

The above illustration is taken direct from a photograph, and shows the construction of an Iron Truss Roof designed and built by us for the Connecticut Electric Company, at Waterbury, Conn. The building is 51 feet in width by 251 feet in length, with brick walls and iron truss roof covered with corrugated iron. For an Electric Light Station, where the risk from fire is very great, this construction particularly commends itself, as this risk is entirely eliminated.

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THE MANAGEMENT OF SMALL GAS WORKS.

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NEW YORK AND PHILADELPHIA,

CHICAGO, ST LOUIS,

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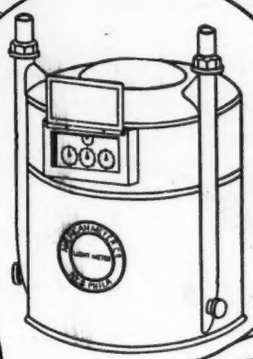
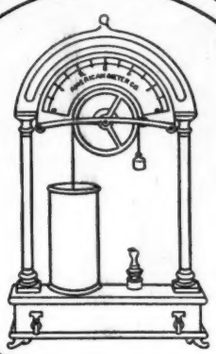
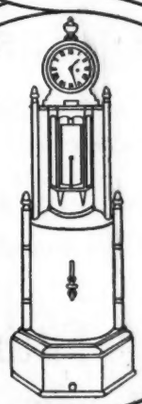






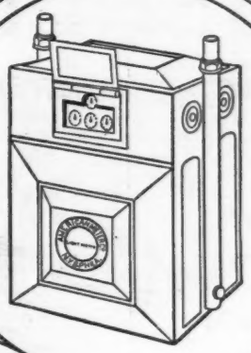
PUBLIC LIGHTING TABLE.

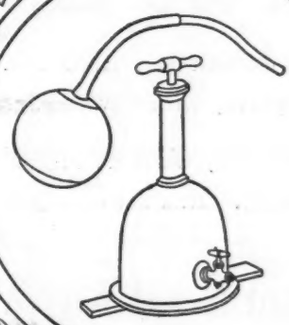
JULY, 1895.

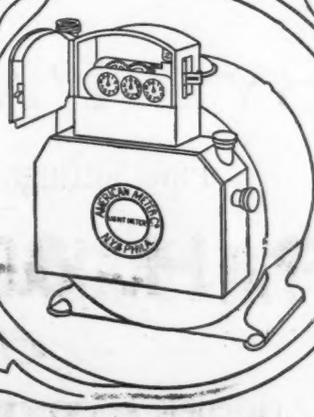
Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Mon.	1	11.50 PM	3.40 AM	7.30	3.15
Tue.	2	12.20 AM	3.40	7.30	3.15
Wed.	3	1.00	3.40	7.30	3.15
Thu.	4	1.50	3.40	7.30	3.15
Fri.	5	No L.	No L.	7.30	3.15
Sat.	6	No L. FM	No L.	7.30	3.15
Sun.	7	No L.	No L.	7.30	3.15
Mon.	8	8.00 PM	10.00 PM	7.30	3.15
Tue.	9	8.00	10.20	7.30	3.15
Wed.	10	8.00	10.50	7.30	3.15
Thu.	11	8.00	11.10	7.30	3.15
Fri.	12	8.00	11.30	7.30	3.15
Sat.	13	8.00	11.50	7.30	3.15
Sun.	14	8.00 LQ	12.10 AM	7.30	3.15
Mon.	15	8.00	12.30	7.30	3.15
Tue.	16	8.00	1.00	7.20	3.15
Wed	17	8.00	1.40	7.20	3.15
Thu.	18	8.00	3.50	7.20	3.15
Fri.	19	8.00	3.50	7.20	3.15
Sat.	20	8.00	3.50	7.20	3.15
Sun.	21	7.50 NM	3.50	7.20	3.15
Mon.	22	7.50	3.50	7.20	3.15
Tue.	23	7.50	3.50	7.20	3.15
Wed.	24	7.50	3.50	7.20	3.15
Thu.	25	7.50	3.50	7.20	3.15
Fri.	26	9.00	3.50	7.20	3.15
Sat.	27	9.20	3.50	7.20	3.15
Sun.	28	9.50 FQ	4.00	7.20	3.15
Mon.	29	10.20	4.00	7.20	3.15
Tue.	30	11.00	4.00	7.10	3.30
Wed.	31	11.50	4.00	7.10	3.30

TOTAL HOURS LIGHTING DURING 1895.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	237.00	January	423.20
February	196.40	February	355.25
March	195.50	March	355.35
April	165.30	April	298.50
May	153.40	May	264.50
June	138.20	June	234.25
July	146.30	July	243.45
August	152.50	August	280.25
September	165.10	September	321.15
October	186.10	October	374.30
November	204.10	November	401.40
December	219.30	December	433.45
Total, yr.	2161.20	Total, yr.	3987.45







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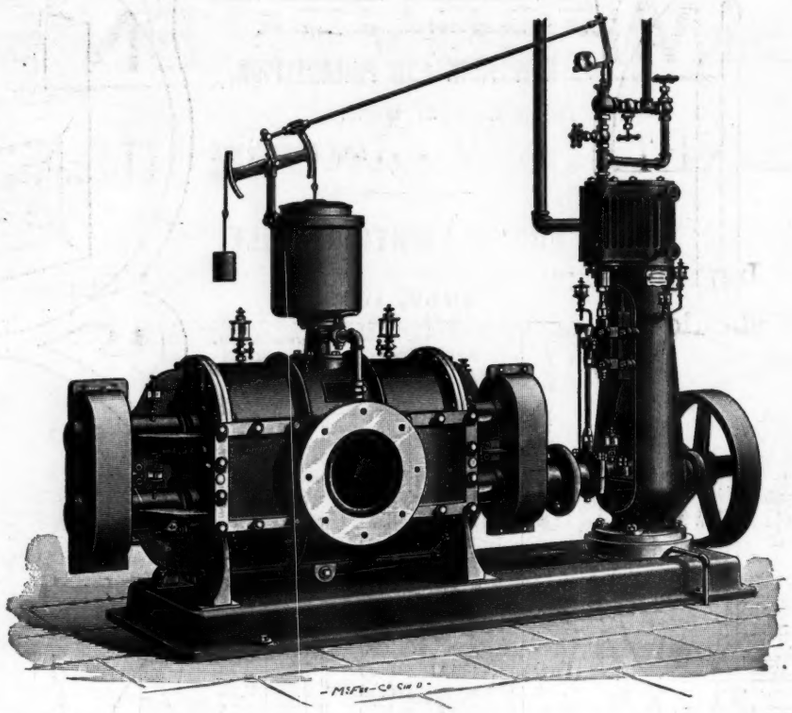

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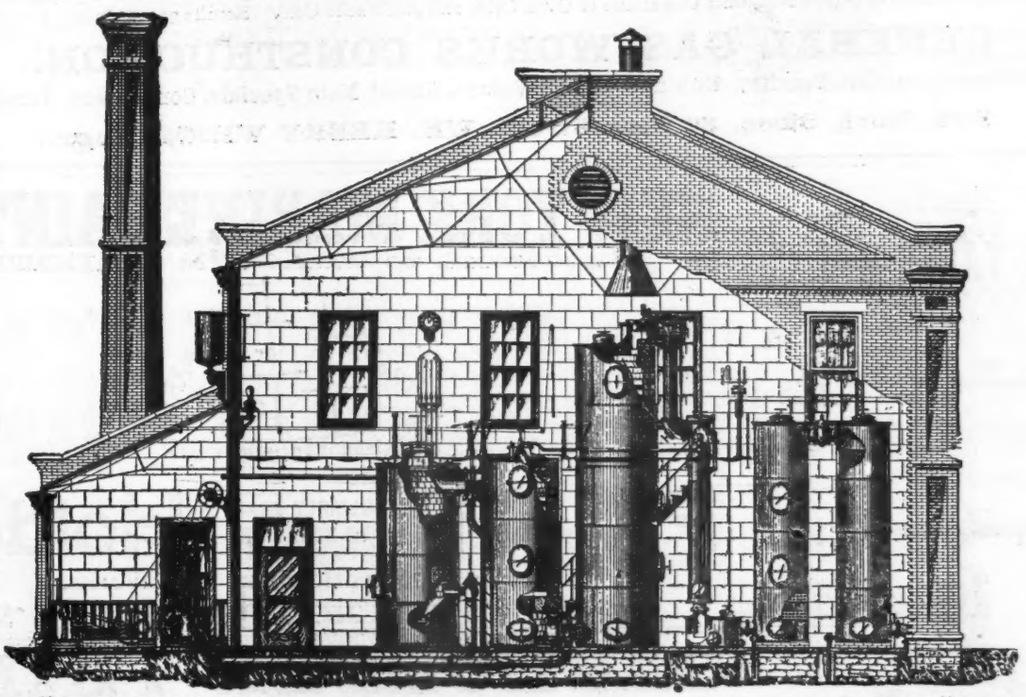

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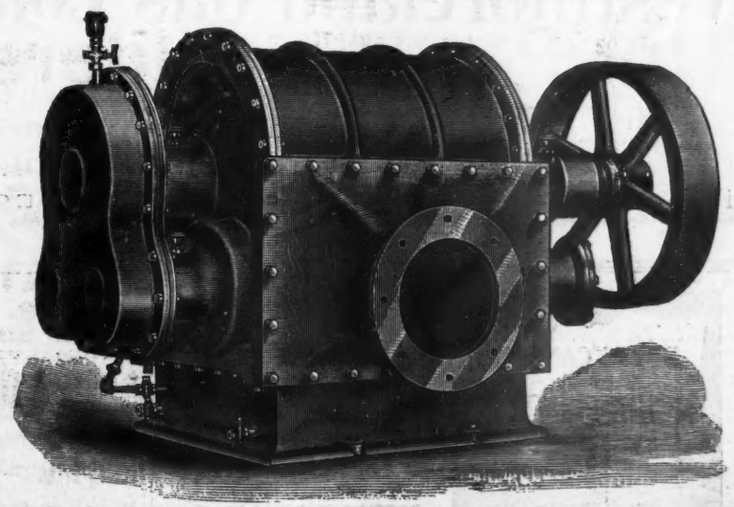

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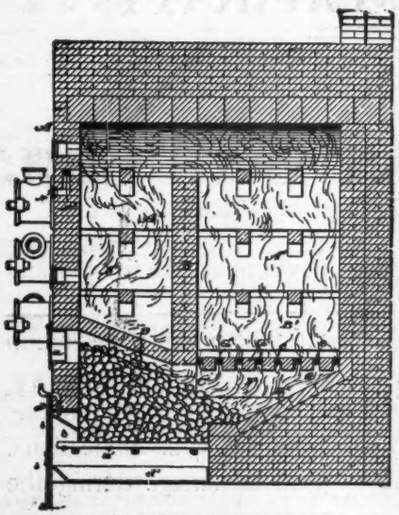

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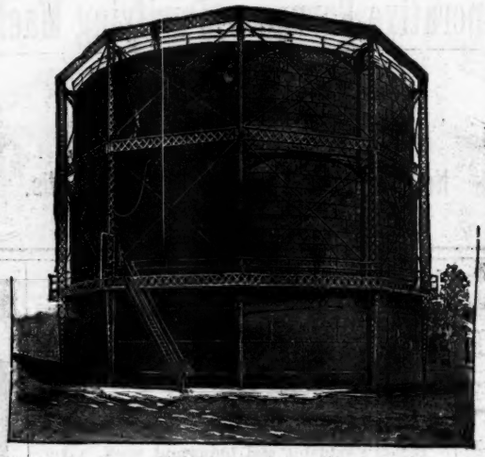

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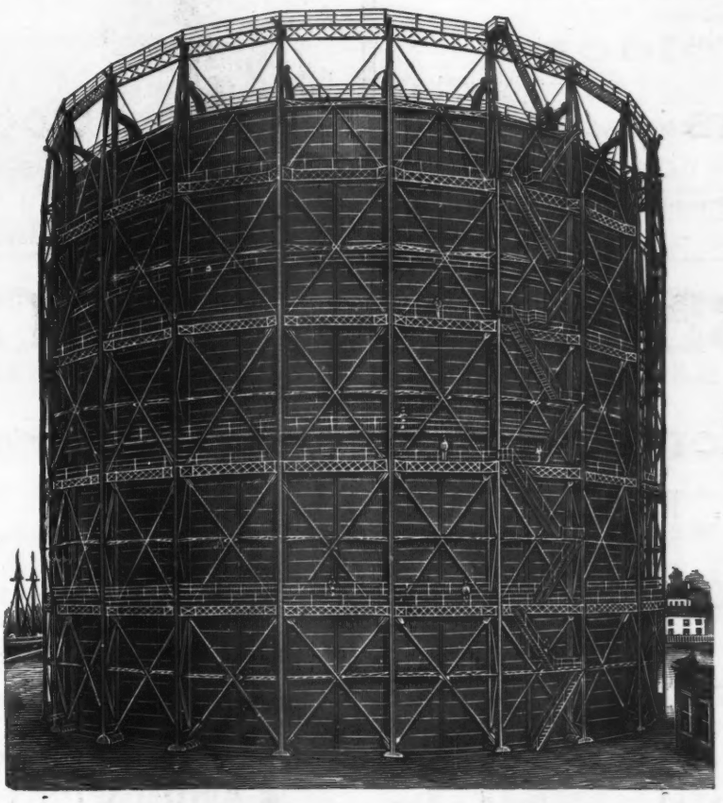

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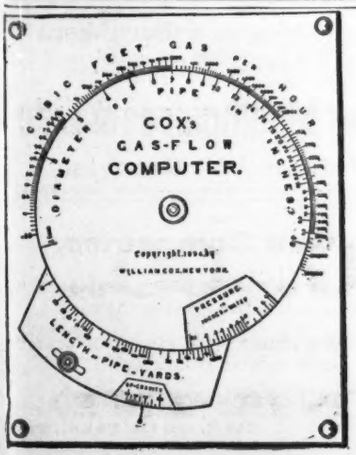

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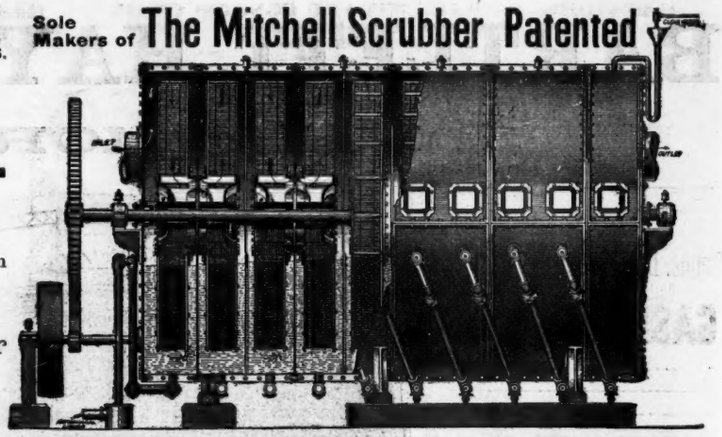

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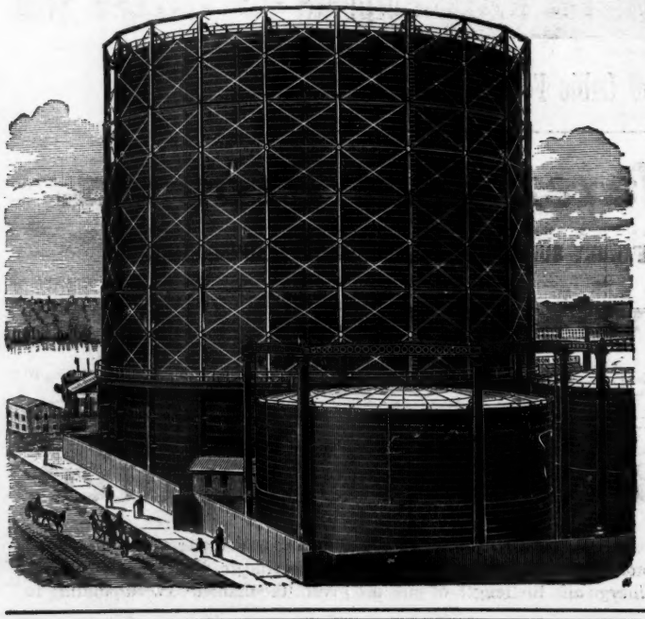

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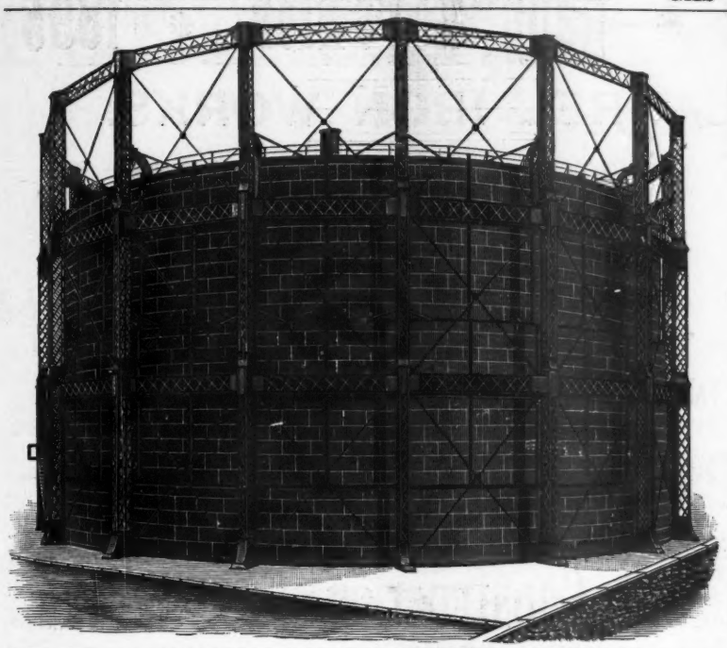

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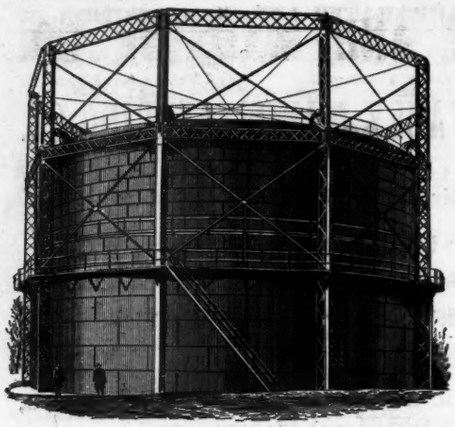

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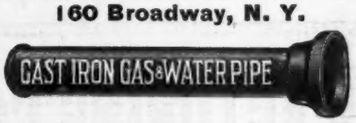

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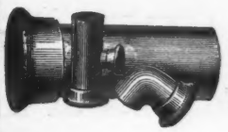

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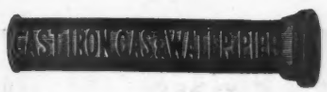

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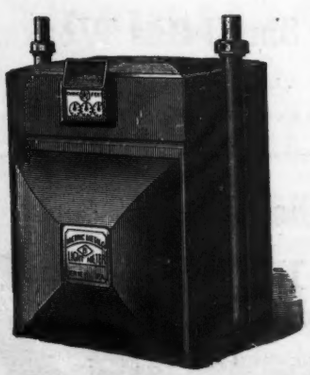

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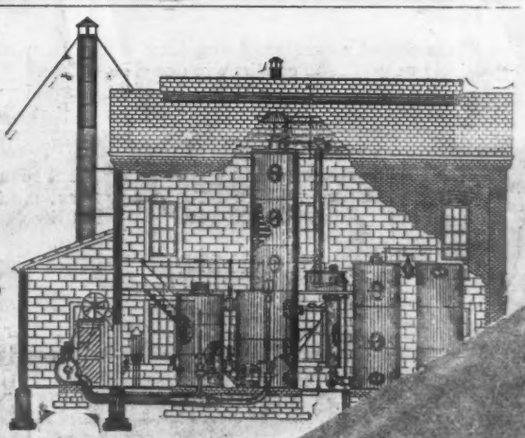

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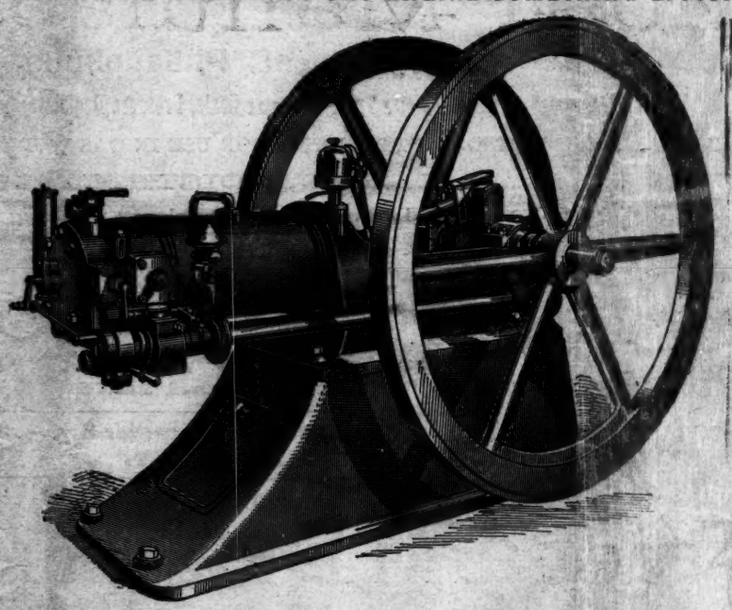

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